DIVISION OF MINES

MISCELLANEOUS PAPER 67

SUMMARY OF FIELD WORK, 1976

by the

GEOLOGICAL BRANCH

Edited by

V.G.Milne, W.R.Cowan, K.D.Card and J.A.Robertson

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SUMMARY OF FIELD WORK, 1976

by the

GEOLOGICAL BRANCH

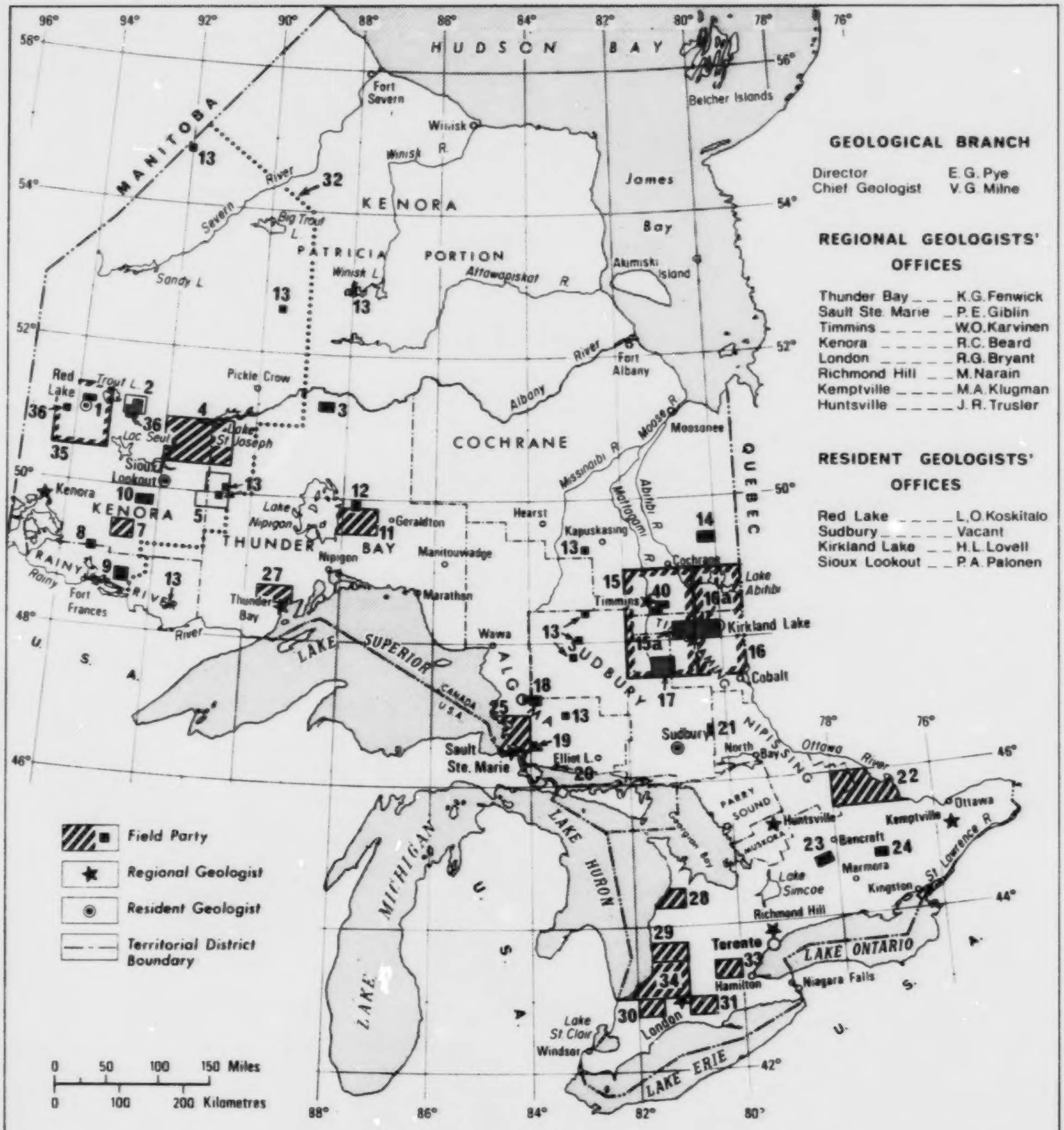
DIVISION OF MINES

PREFACE

In the summer of 1976, the Geological Branch, Ontario Division of Mines, conducted field work on 35 geological projects, 1 geophysical project and 3 geochemical projects. Cooperative geochronologic studies were initiated on a number of geological problems by staff of the Branch and of the Department of Mineralogy and Geology, Royal Ontario Museum, and airborne radiometric and lake sediment geochemical surveys were also undertaken in cooperation with the Geological Survey of Canada.

The locations of the areas investigated are shown on the map of the Province, at the beginning of this report. The preliminary results of the work are outlined in this summary, which contains reports prepared by leaders of each of the projects. In these reports, some emphasis has been placed on the economic aspects of the different investigations. It is the hope of the Geological Branch that the information thus provided will help in the mineral resource evaluation of these areas and so will be a valuable aid to mineral prospecting and resource planning in the Province. Also as a direct result of this summer's work, research was undertaken on seven theses at the B.Sc. and Graduate level.

Coloured maps and final detailed reports covering most of the field projects are being prepared for publication. In the interim, however, uncoloured preliminary geoscience maps with comprehensive marginal notes, will be released for distribution mostly during the winter of 1976-1977. These will mainly be published at the field scale of 1 inch to ¼ mile, 1 inch to 1 mile, or 1 inch to 2 miles. Notices of the releases will be mailed to all persons or organizations on the Ontario Division of Mines notification list, and will be published in the technical journals and other media.


HUDSON BAY
James Bay
Belcher Islands
MANITOBA
KENORA
PATRICIA PORTION
COCHRANE
THUNDER BAY
ALGOMA
SUDBURY
NIPISSING
PARRY SOUND
MUSKOKA
QUEBEC
RAINY RIVER
U. S. A.
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ONTARIO
LAKE ERIE
Georgian Bay
Lake Simcoe
Lake St. Clair
Lake Nipigon
Lake Abitibi
Lac Seul
Lake St. Joseph
Ottawa River
St. Lawrence R.
Albany River
Attawapiskat R.
Severn River
Winisk R.
Missinaibi R.
Moose R.
Mattagami R.
Abitibi R.
Fort Severn
Winisk
Big Trout L.
Sandy L.
Winisk L.
Akimiski Island
Fort Albany
Moosonee
Pickle Crow
Red Lake
Trout L.
Sioux Lookout
Kenora
Fort Frances
Thunder Bay
Nipigon
Geraldton
Manitouwadge
Marathon
Hearst
Kapuskasing
Cochrane
Timmins
Kirkland Lake
Cobalt
Wawa
Sault Ste. Marie
Elliot L.
Sudbury
North Bay
Huntsville
Bancroft
Marmora
Kingston
Kemptville
Ottawa
Richmond Hill
Toronto
Hamilton
Niagara Falls
London
Windsor
CANADA
U.S.A.
1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 15a, 16, 16a, 17, 18, 19, 20, 21, 22, 23, 24, 25, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 40
96°, 94°, 92°, 90°, 88°, 86°, 84°, 82°, 80°, 78°, 76°
58°, 56°, 54°, 52°, 50°, 48°, 46°, 44°, 42°
▨■ Field Party
★ Regional Geologist
◉ Resident Geologist
Territorial District Boundary
0 50 100 150 Miles
0 100 200 Kilometres

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Chief Geologist	V. G. Milne

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Sioux Lookout	P. A. Palonen

LOCATION OF FIELD PARTIES, 1976

GEOLOGICAL BRANCH
DIVISION OF MINES

ODM 4045 A

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Precambrian
Geology
Section

PRECAMBRIAN GEOLOGY SECTION SURVEYS, 1976

V.G. Milne[1]

Bedrock geological surveys and regional studies of six major geological belts and tectonic provinces in the Precambrian Canadian Shield area were conducted during the 1976 field season. In all 25 projects were undertaken and of these 19 were directed by staff of the Section, five by contract staff and one by a Regional Geologist. About 2980 km^2 (1,150 square miles) were mapped at detailed scale (1:31,680 or 1:12,000) and approximately 7800 km^2 (3,000 square miles) at reconnaissance scale (1:63,360 or 1:126,720).

In the Uchi Lake Belt a detailed mapping project was completed in the Attwood Lake area (Report No. 3), and in the Red Lake area detailed mapping was continued (No. 1) with the objective of developing an integrated regional geologic framework of the camp in conjunction with geophysical (No. 35) and geochemical surveys and mineral deposit studies (No.36). A synoptic project (No. 2) initiated in 1975 in the Confederation Lake area was completed in 1976. The goal of this survey is the correlation of available detailed mapping and establishment of regional structural and stratigraphic interpretation over a 1000 km^2 (400 square mile) area encompassing the South Bay Mine.

The English River Gneiss Belt has now been mapped at a reconnaissance scale from the Manitoba border to Savant Lake using helicopter support. Prior to this mapping, little was known of the composition, structure and regional relationships within the Belt. It has now been clearly established that the Belt has a dual character with the north half composed largely of migmatized metasediments and the south half dominated by granitoid intrusive rocks and granitoid gneiss (No. 4). The data provides new insight into the relationship of uranium and lithium mineralization to anatectic and tectonic features, and into the genetic and tectonic relationship of the Gneiss Belt to the metavolcanic Uchi Lake and Wabigoon Belts.

In the Wabigoon Belt, two detailed surveys were completed (No. 8 and 12) and two others continued (No. 9 and 10). In addition synoptic surveys correlating stratigraphy and structure in the Upper Manitou (No. 7) and Sturgeon-Savant Lakes (No. 5) areas were completed and another in the Sturgeon River gold area (No.11) is continuing. A special investigation of the western section of the Wabigoon Belt extending from Crow Lake to Savant Lake (No. 6) was initiated in 1976 to integrate the detailed mapping over this large region, and to develop correlation between areas such as the Sturgeon Lake base metal camp, the Manitou Lakes, and the Crow Lake areas, as a basis for understanding the evolution of this metavolcanic-metasedimentary domain and the mineral deposits it contains.

---

[1] **Chief Geologist and Chief, Precambrian Geology Section, Geological Branch, Ontario Division of Mines, Parliament Buildings, Toronto.**

In the Abitibi-Wawa Belt two detailed projects (No. 14 and 18) and three compilation and synoptic projects (No. 15a, 16a and 17) were completed. Work on the eastern part of this Belt is being coordinated into a special study of the Timmins-Kirkland Lake area (No. 15 and 16). This work has already facilitated the recognition of regional stratigraphic units and volcanic differentiation trends, invaluable for the ultimate understanding of mineral deposit genesis, and an additional benefit has been the development of a better means of chemically classifying volcanic rocks (Miscellaneous Paper 66 by L.S. Jensen, see Report No. 16).

In the Southern tectonic province, two detailed projects (No. 19 and 21) were completed and work continued on a special study of Huronian volcanic rocks (No. 20), extending from Sault Ste. Marie to Sudbury to determine their character and relationship to uranium mineralization in associated conglomeratic sedimentary units.

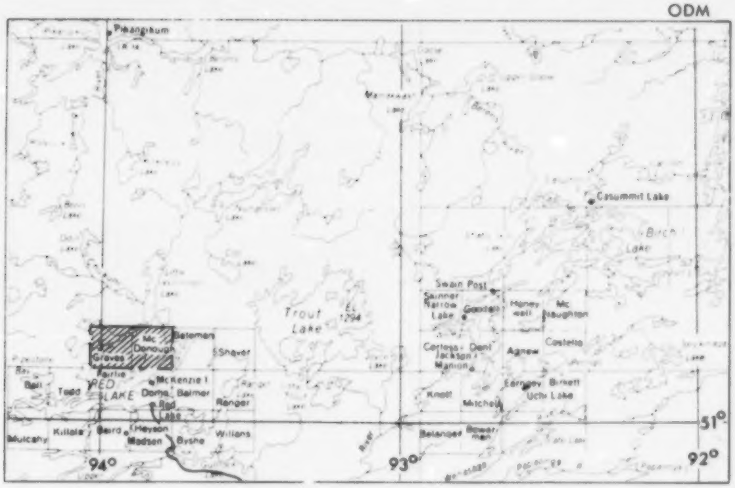
In the Grenville tectonic province, detailed work was completed in the Anstruther uranium area (No. 23) and in the Clarendon Lake gold area (No. 24) and a regional reconnaissance (No. 22) of the Middle-Late Precambrian boundary zone in the Pembroke area was largely completed. This boundary is considered of major significance in relation to the uranium mineralization area extending southwest through the Bancroft region.

The summaries represent rapid syntheses of geological field data as do the Preliminary Maps which are in preparation for publication during the winter of 1976-1977. These field reports and maps are designated as means of rapidly disseminating highlights and general outlines of new information. More extended analysis of field data in conjunction with detailed office and laboratory research for final report and map publication can be expected to result in changes to the field terminology, interpretations, and concepts expressed.

NO. 1 McDONOUGH-GRAVES TOWNSHIPS AREA

DISTRICT OF KENORA, PATRICIA PORTION

James Pirie[1]


ODM
Pikangikum
Casummit Lake
Birch Lake
Swain Post
Skinner Narrow Lake
Goodall
Honeywell
McNaughton
Trout Lake
EL 1294
Bateman
McDonough
Graves
Shaver
Fairlie
RED LAKE
McKenzie I
Dome
Balmer
Red Lake
Ranger
Bell
Todd
Killala
Baird
Heyson
Madsen
Byshe
Mulcahy
Willans
Cortess
Dent
Jackson
Manion
Agnew
Costello
Knott
Mitchell
Earngey
Birkett
Uchi Lake
Belanger
Bowerman
51°
94°
93°
92°

LOCATION MAP Scale: 1:1,584,000 or 1 inch to 25 miles

INTRODUCTION

Mapping of McDonough and Graves Townships at a scale of 1 inch to 880 feet (1:10,560) was completed during the 1976 field season as part of a two year program which in 1977 will be continued eastward to include Bateman and Balmer Townships. The map-area which is centred 15 km (9 miles) north of the town of Red Lake is bounded by Latitudes 51°06′20″ and 51°11′31″N, and Longitudes 93°45′46″ and 94°02′18″W, and is due north of Dome Township mapped by Ferguson (1966) and Fairlie Township mapped by Riley (1971).

ACCESS

Much of McDonough Township along with the southeast corner of Graves Township is accessible by boat from Red Lake, and the rest of the area is accessible to float-equipped aircraft from the network of lakes southwest of Little Vermilion Lake.

MINERAL EXPLORATION

Ferguson (1966) indicated that the first discovery of gold in the Red Lake area was made in 1897 near Slate Bay in McDonough Township. Although the metavolcanic-metasedimentary belt has been extensively prospected for gold since about 1925, no properties within the present map-area were brought to production despite intensive trenching and drilling around favourable showings close to the bays of Red Lake.

Since the early 60s, attention has been focussed more on the base metal potential of the belt. Much of the more recent exploration work in the area has been carried out by Cochenour Explorations Limited who between 1958 and 1967 diamond drilled some 2118 m (6,950 feet) in 25 holes on their Slate Bay Group at the head of Slate Bay. Airborne electromagnetic and magnetic surveys by Cochenour Explorations Limited outlined a number of anomalies which were then more accurately delineated by detailed ground electromagnetic surveys. In 1966 a number of anomalous zones on their East and West Groups at "Goldseekers" Bay were tested by 1157 m (3,798 feet) of diamond drilling in 12 holes. At the same time they drilled 280 m (919 feet) in three holes on their Hoyles Bay Group. Between 1966 and 1970 similar zones were tested on their Ballnik Group by 709 m (2,328 feet) of diamond drilling in 12 holes, and further electromagnetic surveys, followed by 287 m (942 feet) of diamond drilling in five holes were carried out in 1972. In 1974 following electromagnetic and magnetic surveys on their Post Narrows Group, some anomalous zones were tested by 430 m (1,412 feet) of diamond drilling in five holes.*

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[1] Geologist, Precambrian Geology Section, Geological Branch, Ontario Division of Mines, Parliament Buildings, Toronto.

In 1966 The International Nickel Company of Canada Limited diamond drilled 159 m (521 feet) in three holes in the Hoyles Bay area, presumably to test geophysical conductors.*

In 1937 Luxor Red Lake Mines Limited carried out 610 m (2,002 feet) of diamond drilling in seven holes to test possible gold-bearing zones on the west side of Slate Peninsula. In 1962 ground electromagnetic and magnetic surveys outlined several conductive zones which were tested by 500 m (1,643 feet) of diamond drilling in four holes, and an additional 610 m (2,002 feet) in 1965.*

GENERAL GEOLOGY

Previous geological mapping in the two townships included work by Horwood (1945) and Donaldson (1969), and a preliminary compilation map of the south part of McDonough Township was produced by Ferguson (1961). The general northeasterly trend of units mapped by Riley (1971) in Fairlie Township and by Ferguson (1966) in Dome Township continues into the present map-area. The sequence of Early Precambrian metavolcanics and metasediments is increasingly recrystallized and foliated towards the north and northwest where it is in contact with a coarse-grained composite granitoid batholith which underlies most of Graves Township.

In the southeast quadrant of McDonough Township a northeast-trending sequence of mafic metavolcanic units with pillowed variolitic tops and medium-grained, massive interiors is interbedded with metasediments. In places the metasediments consist of up to 150 m (500 feet) of thin to medium-bedded wacke-mudstone with minor conglomerate, and elsewhere much thinner units of shale, graphitic shale, chert, ferruginous chert and marble. Here and there in the sequence debris flow deposits of volcanic material occur. Along the west shore of Post Narrows a thin unit of distinctive mafic flows with medium- to coarse-grained radiating and parallel branching arrangements of amphibole occurs within the more typical pillowed volcanic flows. On the southeast shore of Hoyles Bay a felsic flow breccia with minor tuff horizons reaches a thickness of some 240 m (800 feet) but apparently wedges out gradually to the southwest. Near the top, the unit is more heterolithologic, showing evidence of reworking, and is capped by thin-bedded chert and oxide iron formation.

Much of the remainder of the belt consists of a thick sequence of metasediments with one major mafic volcanic unit around and to the north of Slate Bay. The metasediments are medium-bedded wacke-mudstone with considerable thicknesses of coarse, poorly stratified, polymictic pebble to cobble conglomerate. To the northwest and north the metasediments grade into more mature arkose and conglomerate, the latter containing only clasts of resistant vein quartz, banded chert and felsic to intermediate intrusive and extrusive rocks. In a zone 900 m (3,000 feet) wide along the contact with the batholithic rocks, the sedimentary and volcanic rocks have been metamorphosed to biotite and hornblende schists. In places these schists appear to be lapilli tuffs and minor flows of intermediate composition but elsewhere these rocks may represent volcaniclastic wacke and conglomerate. Elongate zones and rafts of similar biotite and hornblende schist occur within the batholithic rocks in Graves Township.

Prior to low grade metamorphism, the volcanic and sedimentary rocks were intruded by a number of thick sheets of coarse-grained leucogabbro and minor medium-grained peridotite. West of Slate Bay the sequence has been intruded by a number of large stocks and associated dikes of fine-to medium-grained biotite trondhjemite commonly containing quartz eyes. Throughout the rest of the area, narrow dikes of fine-grained quartz and feldspar porphyry are common. A few thin dikes of lamprophyre occur here and there in the area.

---

*Information from Resident Geologist's Files, Ministry of Natural Resources, Red Lake.

The batholithic rocks which underlie most of Graves Township and the northern part of McDonough Township are intrusive into the schistose metasediments and metavolcanics. The rocks are mostly coarse-grained, pink, vaguely foliated, biotite-hornblende trondhjemite to quartz diorite with a color index of 10 to 20, and containing 10 to 20 percent quartz. Locally, microcline porphyroblasts occur in substantial amounts in this rock unit.

Zones of layered biotite and hornblende schists are common and in places impart a strongly layered structure to the batholithic rocks. Near the margins of the zones, the schists are intruded and partially assimilated by the granitoid rocks. Throughout the batholith, small bodies, sheets and stringers of pink medium-grained leucocratic trondhjemite and associated pegmatite intrude the earlier material.

The trondhjemitic phases are in turn cut by a large, very coarse grained, pink, biotite granodiorite stock with porphyritic microcline and sub-porphyritic quartz, occupying the southwest quadrant of Graves Township. The granodiorite also occurs as dikes and sheets in the rest of the batholithic area. Closely related, coarse quartz monzonite pegmatite and aplite sheets, veins and stringers cut the main porphyritic granodiorite and surrounding rocks.

STRUCTURAL GEOLOGY

Primary depositional structures such as pillows in the mafic metavolcanics, and graded bedding in the tuff and wacke layers are present in sufficient quantity to outline some major isoclinal folds in the sequence.

A synclinal axis trends northeast through the metasediments west of Post Narrows and a complementary anticlinal axis with similar trend is apparent at the south end of Slate Peninsula, again centred in a metasedimentary unit. West and northwest of the anticline virtually all primary structures indicate younging of the sequence to the northwest and a similar sense is indicated in the rocks southeast of the syncline, suggesting that the gross structure is like a huge drag fold with the pile younging generally from southeast to northwest towards the batholith.

Minor drag folds and small isoclinal folds are found sparingly in the layered rocks throughout the area and generally have a steep to vertical plunge suggesting a similar attitude in the major folds. The typical northeast-trending foliation present throughout the metasediments and metavolcanics parallels the axial planes of minor isoclinal folds and probably of the major folds also.

Towards the batholithic contact the rocks have developed a strong, steep to vertical schistosity striking parallel to the contact, which trends NNE in the south and swings closer to east in the northern part of McDonough Township. Schistosity in the zones and rafts of schist within the batholith is generally parallel to their direction of elongation. To the southeast of Corallen and Alford Lakes these schist zones have only moderate dips to the northwest whereas elsewhere the dip is steep to vertical as is the foliation in the enclosing granitoid rocks. Further into the batholith in the northwest corner of Graves Township, the foliation strikes in a more southeasterly direction which is almost normal to the general trend nearer the batholithic contact.

ECONOMIC GEOLOGY

Gold

Visible gold was noted in one pit on the shore of Goldseekers Bay of Red Lake. The gold occurs in a 1 m (3 feet) wide quartz vein which strikes N18W and pinches out inland over about 8 m (26 feet). Scattered, small aggregates of arsenopyrite, sphalerite, galena and pyrrhotite also occur in the vein which cuts a thin unit of intermediate lapilli tuff. Elsewhere in the area, a number of samples were taken for assay from old pits in quartz veins and sulphide iron formation. The best values[1] were 0.03 ounces gold per ton and 0.17 ounces silver per ton, in a sample from a quartz vein containing fuchsite (?), located some 240 m (800 feet) southwest of the small bay at the head of Slate Bay. None of these samples contained significant arsenic[1] which is a common constituent of gold deposits in the Red Lake area. As well as the quartz veins and iron formation horizons several zones of carbonatized mafic metavolcanics have been prospected as possible sites of gold mineralization with little success.

---

[1] Assays by Mineral Research Branch, Ontario Division of Mines.

Sulphides and Base Metals

Minor disseminated pyrite and pyrrhotite commonly occur throughout the mafic metavolcanics and some of the metasediments as primary constituents. Pyrrhotite-rich iron formation with or without pyrite-bearing graphitic shale is present in thin units throughout the sequence.

Airborne electromagnetic surveys in search of base metal deposits have been carried out over much of the belt. The most common conductors found are thin iron formation units and related graphitic zones. The concept that volcanogenic massive sulphide deposits can occur towards the top of a cycle of mafic to felsic volcanism is often used for selecting exploration targets. By this criterion, the top of the unit of northeast-trending felsic flow breccia and related tuffs, which occurs on the southeast shore of Hoyles Bay east of Post Narrows and extends northwestwards into Bateman Township, may be worthy of exploration attention.

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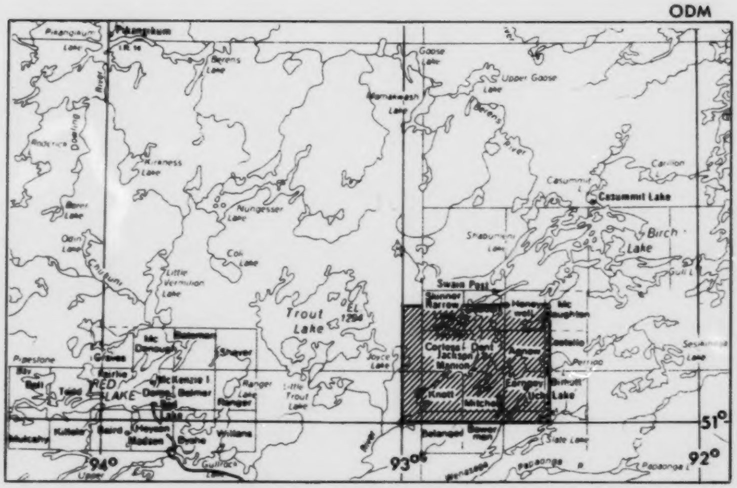
NO. 2 CONFEDERATION LAKES SYNOPTIC PROJECT

DISTRICT OF KENORA, PATRICIA PORTION

P.C. Thurston[1]



LOCATION MAP   Scale: 1:1,584,000 or 1 inch to 25 miles

LOCATION

The area is bounded as shown on the location map, and the center of the area lies about 60 km (40 miles) east of Red Lake. The road to the South Bay Mine extends to the southeast corner of Dent Township from the town of Ear Falls 80 km (50 miles) to the southwest. The road provides access to the Confederation and Woman Lakes water systems, which extend nearly the whole length of the map-area. Access to Honeywell, McNaughton, Agnew and the eastern portion of Earngey Townships is by float-equipped aircraft based in Red Lake or Ear Falls.

MINERAL EXPLORATION

Past mineral exploration in the area has been described by Pryslak (1969, 1970, 1971, 1972), Thurston (1973 and 1974) and Johns and Thurston (1975). Activity in 1976 consisted of staking in western Agnew Township by Kerr Addison Mines Limited and Selco Mining Corporation Limited. Geophysical surveys were conducted over part of this area this summer. Further diamond drilling was conducted during the past winter on the property of Kerr Addison Mines Limited in the Fly Lake area.

GENERAL GEOLOGY

The map-area lies in the southern portion of the Birch-Uchi metavolcanic-metasedimentary belt, within the Uchi Subprovince (Ayres *et al.* 1971). In a previous statement (Thurston 1975) the author suggested that the metavolcanic-metasedimentary belt consisted of four mafic to felsic cycles. As a result of this years work the author has now concluded that only three major volcanic cycles are present in the map-area. In the area east of Corless Lake the lowermost stratigraphic units, consisting of a basal basalt overlain by metasediments and intermediate tuffs, were originally considered by the author (1975) to be the oldest, complete cycle. However, the author now believes that this sequence does not represent a complete cycle but that the clastic units represent only a minor development of sedimentation and pyroclastic activity within a larger first cycle previously recognized by Pryslak (1970, p.17).

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The three mafic to felsic volcanic cycles are folded about a regional synclinorial axis which passes north-south through the belt. West of the synclinorial axis, the rocks of Cycle I, trend north, just east of Corless Lake from the Woman River to east of Narrow Lake where the rocks of Cycle I are engulfed by granitic rocks. East of the fold axis the rocks of Cycle I are exposed in the core of a regional anticlinorium which is centred east of Philchub Lake in Agnew Township and extends south to Leg Lake in Earngey Township. The rocks of Cycle I comprise a maximum thickness of 1717 m (5,650 feet) of pillowed mafic flows capped by about 500 m (1,700 feet) of intermediate pyroclastic rocks and metasediments. Cycle I is capped by a 90 m (300 feet) thickness of siliceous marble in the Narrow Lake area.

Cycle II, west of the synclinorial axis, extends from Quartz Lake to Woman Lake and consists of a basaltic base succeeded upwards by intermediate pyroclastic rocks and felsic metavolcanics. East of the synclinorial axis, the rocks of Cycle II lie on and to the east of Lost Bay of Confederation Lake and east of Fly Lake. They consist of 1600 m (5,250 feet) of interbedded mafic flows and felsic tuffs with minor intermediate flows, succeeded upwards by dacitic pyroclastic rocks which average 486 m (1,600 feet) in thickness. Cycle II is capped in the Woman Lake area by a 45-60 m (150-200 feet) thickness of siliceous marble.

East of the fold axis, Cycle III the uppermost cycle consists of 1428 m (4,700 feet) of basalt which extends northward from the mid-point of Fly Lake through Lost Bay of Confederation Lake and thence northward through the middle of Honeywell Township. The basalt is succeeded upwards by a maximum of 1976 m (6,500 feet) of intermediate pyroclastic rocks and flows and up to 550 m (1,800 feet) of rhyolitic pyroclastics and flows and an endogenous dome of quartz-feldspar porphyry. The stratigraphy west of the fold axis is similar.

The synoptic mapping will result in some revision to previous mapping of most of the area.

Previously unreported rhyolitic tuffs associated with Cycle I were noted at the south end of Narrow Lake where they extend about 1.2 km (0.75 miles) along strike and attain a maximum thickness of 300 m (1,000 feet).

STRUCTURAL GEOLOGY

Strike is almost universally north-trending throughout the belt except in Skinner Township where the basaltic rocks of Cycle II swing to a west-northwesterly strike.

Stratigraphic top determinations based upon graded bedding in metasediments and fine-grained pyroclastic rocks, and pillow shape and packing have been made throughout the belt. The top determinations define a synclinorium of regional scale the trace of the axial plane of which passes down the Goodall-Honeywell Township boundary and southward to the area of the South Bay Mine on the boundary between Dent and Agnew Townships. West of the synclinorial axis, the metavolcanics form an east-facing homoclinal sequence. East of the axis, the rocks of Cycles II and III face west, but the basaltic rocks of Cycles I and II and some of the intermediate pyroclastic rocks are folded into a complex series of isoclinal folds between Lost Bay of Confederation Lake and Uchi Lake.

An anticlinorium of regional scale extends from Leg Lake east of Uchi Lake, northward to just east of Philchub Lake. This fold exposes, at its core, basaltic rocks of Cycle I. Outward to the east and west from this fold, are exposed intermediate pyroclastic rocks, minor felsic pyroclastics and lastly the Slate Lake metasediments (Bateman 1939). Therefore it is now concluded that these metasediments lie at the top of Cycle I in part, although Slate Lake metasediments to the south may be in part time-equivalent not only to Cycle I but to the younger metavolcanics.

A major fault, herein named the Bear Lake fault, extends from Neepawa Bay of Uchi Lake northwestwards through Fly Lake just south of Nekapean Bay, Triangle Lake, South Bay of Confederation Lake and thence west and southwest across the south end of Woman Lake to Bear Lake and the Woman River. The horizontal component of displacement on this fault is left lateral and on the order of 2 km (1¼ miles). The principal marker unit for estimating the horizontal component of displacement is the iron formation unit found at the top of Cycle II on the east side of the fold.

North-trending faults extend the length of both Uchi and Fly Lakes. Offset on these faults is difficult to measure because the structures parallel strike, but the horizontal component of displacement on the Uchi Lake Fault is approximately 1.6 km (1 mile) in a left lateral sense. Vertical displacement on both these features is believed to be appreciable in that the metamorphic grade east of the Uchi Lake Fault is higher than to the west of the fault and grade is again high west of the Fly Lake Fault.

South of the Bear Lake Fault in Mitchell Township, a north-plunging anticline is centred on Nekapean Bay of Fly Lake. The west limb of the fold strikes north immediately south of the fault but swings to the southwest in the vicinity of Horseshoe and Elbow Lakes.

ECONOMIC GEOLOGY

Gold exploration in the map-area has concentrated on gold in quartz veins and chert units associated with Cycle II and III mafic metavolcanics. The Hill Sloan Tivy vein (Thomson 1938) is considered by the author to represent a syngenetic chert unit capping a mesoscopic mafic to felsic cycle, based upon its continuity over about 3 600 m (12,000 feet) and the consistent nature of the footwall, a series of felsic tuffs, and the hanging wall, a unit of mafic hyaloclastite and pillow lava. The abundant hyaloclastite units associated with this chert may have been the source of the gold found in the chert (Keays and Scott 1976).

Compared to the auriferous carbonate units found in the Timmins-Kirkland Lake area, the carbonate units capping Cycles I and II do not have the characteristic green colour, and are calcite (Ca) rich whereas the Timmins-Kirkland Lake units are Fe and Mg rich. In addition, intensive prospecting in the 1920s and 1930s failed to locate any mineral occurrences associated with the unit.

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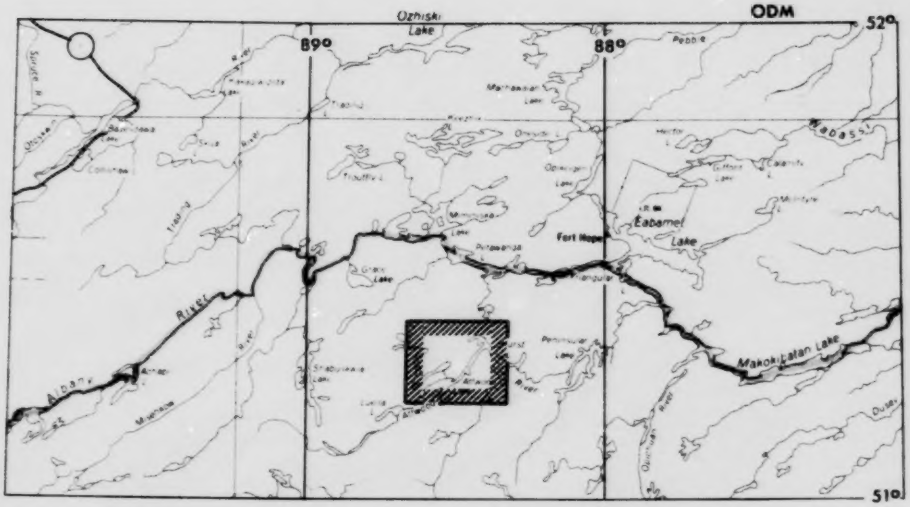
NO. 3 ATTWOOD LAKE AREA

DISTRICT OF THUNDER BAY

Henry Wallace[1]



LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

INTRODUCTION

The Attwood Lake area extends from Latitude 51°12′N to 51°22′30″N and from Longitude 88°20′W to 88°40′W, comprising in total approximately 440 km^2 (170 square miles). The centre of the area is about 120 km (75 miles) ESE of the town of Pickle Lake and 48 km (30 miles) SW of the settlement at Fort Hope.

Access is restricted to float or ski-equipped aircraft which are available for charter from Pickle Lake, Armstrong and Nakina.

MINERAL EXPLORATION

In the past, exploration in the Attwood Lake area has been limited by its remote location and poor accessibility, and by the paucity of geological information available. The area was first surveyed on a reconnaissance scale only in 1969 (Thurston and Carter 1970). Although the area was certainly prospected for gold in the late 1920s and 1930s, none of this work has been recorded, and so far as is known no significant gold occurrences were found. Sporadic activity over the past 15 years has been directed toward the location of base metal sulphide deposits within metavolcanics and mafic intrusions.

In 1961, Boylen Engineering Offices conducted a combined ground magnetic and electromagnetic survey between Attwood and Auger Lakes. This work followed up a previous airborne reconnaissance survey, and was part of a much larger exploration program including ground geophysics, geological mapping, trenching and considerable diamond drilling, which was centred about 9 km (6 miles) northeast of Attwood Lake (Assessment Files Research Office, Ontario Division of Mines, Toronto).

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In 1962, New Jersey Zinc Exploration Company (Canada) Limited carried out geological and ground geophysical surveys along the west side of Weese Lake. Electromagnetic anomalies and surface showings found during this work were investigated by diamond drilling (nine holes totalling 828 m (2,715 feet)) in the winter of 1962-63. No further work was recommended at that time (Assessment Files Research Office, Ontario Division of Mines, Toronto).

An airborne magnetic and electromagnetic survey covering nearly all of the present area, was performed for Canadian Onex Mines Limited in 1970 (Assessment Files Research Office, Ontario Division of Mines, Toronto).

In the spring and summer of the following year, nine diamond drill holes totalling 1197 m (3,923 feet) were put down by Hudson Bay Exploration and Development Company Limited to investigate electromagnetic anomalies around the southern part of Attwood Lake and Attwood and Felsia Lakes.

In 1972, Imperial Oil Enterprises Limited conducted ground magnetic and electromagnetic surveys over eight widely scattered grid systems around Attwood Lake (Assessment Files Research Office, Ontario Division of Mines, Toronto). No follow up work was reported.

During the 1976 field season New Jersey Zinc Exploration Company (Canada) Limited were active in several parts of the area with geological mapping and prospecting.

GENERAL GEOLOGY

Most of this area is underlain by a thick folded sequence of metavolcanics and metasediments which are in contact on all sides, except toward the northeast, with extensive areas of plutonic and migmatitic rock. The Attwood Lake supracrustal sequence extends to the northeast where it connects with the main belt of metavolcanics and metasediments in the eastern Uchi Subprovince (Ayres *et al.* 1971), about 16 km (10 miles) north of Attwood Lake.

All of the exposed rock types are believed to be of Early Precambrian (Archean) age. The oldest rocks present appear to be metasediments which outcrop around the southern and central parts of Attwood Lake and between Attwood and Hurst Lakes. These rocks, which have been metamorphosed under amphibolite facies conditions, are now staurolite, almandine, sillimanite and andalusite-bearing biotitic and sericitic schists which were probably derived from original wacke-type sedimentary rocks. Few primary features are preserved although bedding is discernible in many places. Near the top of the metasedimentary sequence, which is in the order of 1,200-1,500 m (4,000-5,000 feet) thick, there is a succession of polymictic, clast-supported conglomerate units commonly intercalated with arenaceous units and beds of pebbly sandstone. Metamorphosed iron formation units now consisting of variable amounts of amphibole, garnet, biotite, magnetite, iron sulphide minerals, and graphite occur at a number of stratigraphic positions in the metasedimentary sequence. The larger units, up to 100 m (300 feet) thick, are traceable in outcrop and on aeromagnetic maps (ODM-GSC, 1960a, b,c,d) over several thousand metres.

East of Attwood Lake the metasediments are overlain by a metavolcanic sequence, roughly 1,800-2,400 m (6,000-8,000 feet) thick, consisting almost exclusively of basaltic pillow lavas. To the west of Attwood Lake the metasediments are overlain, and in part intercalated with, a mixed sequence of dacitic to andesitic pyroclastic rocks (mostly lapilli-tuff and lapillistone) and basaltic to andesitic pillowed and massive flows now consisting of amphibolite and garnet amphibolite. This sequence extends to the north toward Auger Lake and westward toward Weese Lake where it is overlain in places by a thin accumulation of clastic metasediments. Total thickness of this metavolcanic sequence is difficult to estimate because of folding and faulting.

West of Weese Lake, the metavolcanics are intruded by an anorthositic sill which is some 600 m (2,000 feet) thick, and believed to be continuous with similar bodies to the southwest, one north of Luella Lake and another east of Shabuskwia Lake (McNamee 1962). The anorthosite is in turn cut by a number of minor gabbroic dikes, and in the southwestern corner of the area by pervasive granitoid to pegmatoid quartz monzonite. Elsewhere in the area mafic intrusive rocks are uncommon.

Around the southern end of Attwood Lake the medium to high grade metasediments are in gradational contact with a broad diatexitic (Mehnert 1968) zone consisting of granitoid to pegmatoid quartz monzonitic material interlayered in variable proportions with units of biotite-rich schist. Similarly, to the east of the supracrustal sequence around Hurst and

Felsia Lakes there is a screen of granodioritic to quartz monzonitic rocks containing a high proportion of large metavolcanic inclusions both mafic and felsic, which are strongly aligned parallel to the foliation and other structures in the main supracrustal sequence. North and west of Attwood and Weese Lakes the metavolcanics are in relatively sharp contact with an extensive homogeneous body of foliated quartz monzonite.

The area is covered by a mantle of morainic sand and gravel, particularly thick in the southeastern corner where exposure is very poor.

STRUCTURAL GEOLOGY

The dominant structural features in this area appear to be parallel northeast-trending folds. One such fold is a tight syncline, which has its axial trace extending from north of the mouth of Vertente Bay to between the southern ends of Weese and Attwood Lakes. A second fold is a relatively open anticline with its axial trace extending parallel to Attwood Lake between Attwood and Hurst Lakes. The Weese Lake area is characterized by a three-cornered fold with apices to the north, south and northeast of the main part of that lake.

Structural patterns created by folding are complicated by a large number of WNW- and NW-trending faults with offsets of up to several hundred metres. At roughly right angles to these breaks are a persistent set of major topographic lineaments which are probably also related to fault zones. Within the plutonic terrains in the northeastern and northwestern corners of the area, there are prominent conjugate sets of major joints and faults intersecting at approximately 60 degrees.

ECONOMIC GEOLOGY

Base-metal sulphide mineralization occurs within this area in three very different associations: *1)* pyrite, pyrrhotite and minor chalcopyrite in garnet-amphibole metamorphosed iron formation units; *2)* pyrite, pyrrhotite with minor chalcopyrite in mafic and intermediate metavolcanics, particularly pyroclastic rocks; *3)* chalcopyrite and nickeliferous pyrrhotite associated with the Weese Lake anorthosite body.

Several linear geophysical anomalies in this area have proven to be related to the first type of occurrence. The pyrite and pyrrhotite and in places arsenopyrite form up to 15 percent of the rock. Extensive zones within the iron formation consist of graphite-rich gossan. Chalcopyrite was noted during the present survey in small pods up to several centimetres long occurring with other sulphide minerals, in the less altered rock along the shore in the central part of Attwood Lake. To the north of Attwood Lake between Miminiska and Goss Lakes this type of metamorphosed iron formation has been associated with gold- and sulphide-bearing quartz veins (Wallace 1976) but so far these have not been reported in the present area.

Disseminated sulphide minerals commonly constitute up to 5 percent by volume of intermediate and mafic metavolcanics. Small flecks of chalcopyrite were observed at only two localities in intermediate lapillistone in the Vertente Bay area.

Mineralization in and around the Weese Lake anorthosite intrusion occurs in two forms. The more significant occurrences consist of sparsely disseminated chalcopyrite and pyrrhotite within the anorthosite itself. Reported total sulphide content is only in the order of 1-2 percent overall, but erratic lenses only a few metres in length containing considerable sulphide concentration (mostly pyrrhotite), are known in several places (McNamee 1962). A relatively heavily mineralized block of float of this material was reported to have assayed 0.63 percent copper (McNamee 1962). Chalcopyrite with pyrite also occurs in shear zones and associated quartz veins cutting the anorthosite and younger gabbro dikes along the east side of the main intrusion. The chalcopyrite content is generally erratic, varying from trace amounts to over 30 percent (McNamee 1962). The quartz vein and shear zone systems which are generally north- to northwest-trending are small volumetrically, the largest being traceable for only about 100 m (300 feet) with a width of less than 2 m (6 feet), and certainly do not approach economic significance in themselves.

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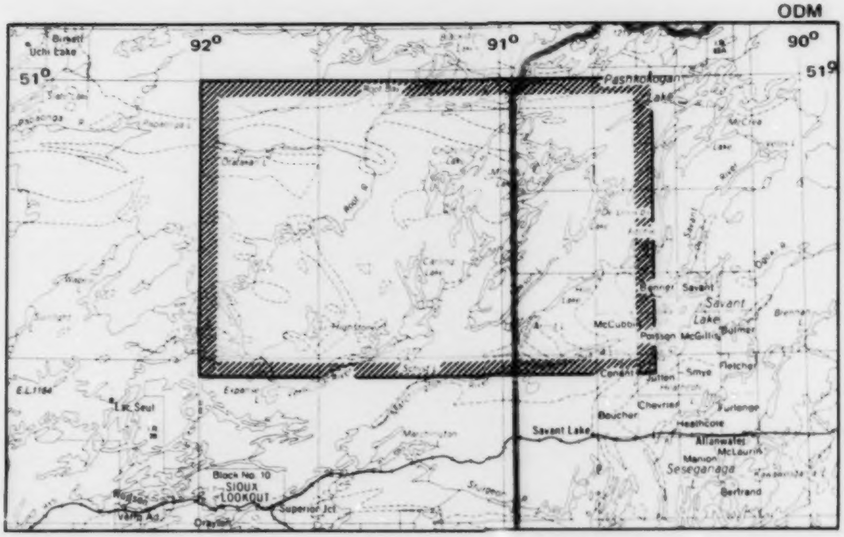
NO. 4 OPERATION MINISS-TULLY LAKES

DISTRICT OF KENORA

F.W. Breaks[1] and W.D. Bond[1]


ODM
92°
91°
90°
51°
51°
Uchi Lake
Pashkokogan Lake
Savant Lake
Savant Lake
McCubbin
Poisson
McGillis
Conant
Jutten
Smye
Fletcher
Chevrier
Boucher
Furlonge
Heathcote
Allanwater
McLaurin
Manion
Sesaganaga
Bertrand
Lac Seul
Block No. 10
SIOUX LOOKOUT
Superior Jct
Sturgeon
Oxdrift

LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

LOCATION

Helicopter-supported reconnaissance mapping of the English River Subprovince that was initiated in 1974 with Operation Kenora-Sydney Lake (Breaks *et al.* 1974) was extended eastward in 1975 with Operation Kenora-Ear Falls (Breaks *et al.* 1975) was continued during the 1976 field season with Operation Miniss-Tully Lakes. The Miniss-Tully Lakes area lies within Latitudes 50°22′30″ and 51°00′N and Longitudes 90°30′ and 92°00′W and embraces an area of approximately 7564 km^2 (2,921 square miles). The area is bounded by Lake St. Joseph in the north, by the northeast part of Lac Seul in the west and by Savant Lake and Highway 599 in the east.

Access by motor vehicle is limited to the extreme eastern margin of the map-area where Highway 599 which extends north from Ignace through Savant Lake to Pickle Lake, runs through the survey area for approximately 56 km (35 miles). West of Highway 599 the remainder of the map-area is accessible by float-equipped aircraft. Air bases are located at the town of Savant Lake (situated 72 km or 45 miles SSE of the centre of the map-area) and Sioux Lookout (situated 97 km or 60 miles) southwest of the centre of the map-area). An extensive network of closely-linked lakes supplemented by numerous, smaller, more isolated lakes offer easy access by boat or canoe throughout the eastern half of the area. In the western portion of the Miniss-Tully Lakes area, except for the Lac Seul Reservoir and the Otatakan Lake-Root River system, access is hampered by the limited number of lakes suitable for float plane landing.

Except for a small, poorly exposed area situated between Lake St. Joseph, Churchill,

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Anenimus and Otatakan Lakes, bedrock exposure is evenly distributed, and is estimated to average 5-10 percent.

Supracrustal and plutonic rocks associated with the Savant Lake "greenstone" belt in the southeast portion of the map-area which have been previously defined by recent detailed mapping were generally examined (only briefly) for correlative purposes.

MINERAL EXPLORATION

Uchi Subprovince

Iron formation has been known to exist in the map-area since the early 1900s (Clifford 1969, p.50) although little serious exploration took place until, in the late 1950s the Lake St. Joseph and Root Lake-McCombe Lake (local name) areas were subject to fairly intense exploration mainly for magnetite-hematite bearing iron formation. Two major iron deposits have been outlined situated on Eagle, Wolf, and Fish Islands in western Lake St. Joseph, and at Doran Lake. The Lake St. Joseph deposit was staked in 1955 by Lake St. Joseph Iron Limited and the property currently consists of 26 patented claims. Development work involved considerable trenching, diamond drilling (approx. 3600 m or 12,000 feet) and benefication testing. In 1974 a 5 year option was granted to the Algoma Steel Corporation Limited (Canadian Mines Handbook 1975-1976, p.165). Approximately 240 million tons averaging 35 percent iron to a 120 m (400 feet) depth and amenable to open pit mining methods have been proven to date (Canadian Mines Handbook 1975-1976, p.165).

In 1956 the Doran Lake deposit was staked by Lun-Echo Gold Mines Limited and subsequent development work outlined two zones of iron formation containing a combined 204,856,500 tons grading 19.2 percent magnetic iron (Goodwin 1965, p.54).

In 1957 Continental Mining Exploration Limited was active in two areas of the Uchi Subprovince. In 1957 magnetic and electromagnetic surveys were conducted on a 30-claim group situated approximately 6 km (4 miles) west of Root Bay of Lake St. Joseph and a 22-claim block just north of McCombe Lake. Anomalies in the McCombe Lake claim group were tested by eight diamond drill holes totalling 1023 m (3,357 feet) before the claim groups lapsed. Also in 1957 El Sol Gold Mines Limited held 18 claims about 3 km (2 miles) west of McCombe Lake and straddling the western boundary of the present map-area. Exploration work centred upon evaluation of a circular magnetic anomaly evident in ODM-GSC aeromagnetic map 891G.

In 1958 Tiara Mines Limited conducted a ground magnetic survey over a 50-claim group to investigate several linear magnetic anomalies in the Root Bay area of Lake St. Joseph.

Discovery of lithium mineralization in the form of spodumene bearing pegmatitic dikes near the Roadhouse River about 6 km (4 miles) east of McCombe Lake in 1955 by Capital Lithium Mines Limited promoted moderate activity in the immediate area. This company undertook detailed geological mapping (1 inch to 200 feet or 1:2400 scale) and chip sampling, and reported LiO_2 values ranging from 0.43 percent to 3.06 percent over 1.5 m (5 feet). The main claim group (28 patented claims) situated along the Roadhouse River was probed by five diamond drill holes totalling 794.2 m (2,605.5 feet) in an area about 0.4 km (¼ mile) south of the main lithium showing. No significant spodumene mineralization was revealed in any of these diamond drill holes. An estimated 2.3 million tons averaging 1.3 percent LiO_2 has been outlined to the 150 m (500 feet) level (Skinner 1969, p.8). A subordinate group of five patented claims which extends north from the shoreline of Root Lake was investigated by two diamond drill holes totalling 248 m (813 feet). The best intersection revealed only 0.13 percent LiO_2 over 0.8 m (2.5 feet). An additional claim block (34 claims) situated at the northeast end of Root Lake was investigated in 1952 by Capital Lithium Mines Limited for possible sulphide mineralization. Magnetometer and electrical resistivity ground surveys were conducted as follow up to an airborne magnetic and electromagnetic survey. Five holes totalling 988 m (3,240 feet) encountered no significant mineraliztion and the claims lapsed.

English River Subprovince

Within the portion of the map-area that is underlain by the English River Subprovince there has been only a minimal amount of exploration interest thus far. Assessment work submitted to date indicates that most of the exploration interest has centred around the Highstone Lakes area.

The earliest recorded mineral exploration is the work done by McCombe Mining and Exploration Limited situated to the southeast of Bury Lake and documented by Hudec (1965). Approximately 40 claims were staked initially in 1955 but the property was expanded in 1959 to include 142 claims. The property consisted of two claims blocks: a large claim group located west and northwest of Moose Lake (the "Moose Lake Group") and a smaller claim group situated on the southeast side of Bury Lake (the "Bury Lake Group"). At that time trenching and prospecting were accomplished on both of these properties. Also, in 1959 an aeromagnetic survey was completed and indicated a number of anomalous zones associated with and on strike with some of the mineralized showings. According to Hudec (1965, p.23) the mineralization at the Bury Lake trenches consists of massive pyrrhotite, pyrite and magnetite carrying traces of chalcopyrite, pentlandite and silver hosted by a "highly siliceous rock and associated with quartz veins". Grab samples taken by company representatives assayed 0.03 to 0.12 ounces silver per ton, 0.05 to 0.85 percent copper; 2.54 percent zinc; 0.02 to 0.41 percent molybdenite and 0.03 to 0.69 percent molybdenum.

Cheskirk Mines Limited controlled a 60-claim group extending from the western end of Wesley Lake to beyond the map-area's western boundary at Longitude 92°00′. An airborne magnetic-electromagnetic survey disclosed the presence of four anomalous zones, and was succeeded by ground magnetic and an electrical resistivity check surveys. In 1957 the anomalous zones were tested in 19 diamond drill holes totalling 2211 m (7,253 feet), but economic sulphide mineralization was not encountered and the claims lapsed.

Rowland Engineering Company Incorporated staked a group of 16 claims at Chamberlain Narrows on Lac Seul in March 1957 and conducted a magnetometer survey to evaluate possible magnetite rich zones that were believed to be present. The survey was completed over 12 of these claims (Williamson and Hudec 1959, p.11) on a 120 m (400 feet) grid system of cut lines with readings being taken at 30 m (100 feet) intervals. Approximately 24 north-trending anomalies were located. A subsequent electromagnetic survey indicated no significant conductive zones were present. The present mapping disclosed the anomalous zone to be associated with magnetite-bearing sodic and potassic plutonic rocks.

From 1967 to 1969 the Canadian Nickel Company Limited undertook extensive exploration that probably included the entire map-area. The only work submitted as assessment credit was follow-up diamond drilling including 12 holes for a total of 688.8 m (2,260 feet). Two holes were drilled near a small lake situated 6 km (4 miles) southwest of the north end of St. Raphael Lake. A third holes was sunk 0.8 km (½ mile) west of Elbow Lake and the remaining nine holes were located between Bury and Moose Lakes. All of these holes intersected predominantly metasedimentary migmatites, locally with minor amphibolite zones and minor disseminated pyrrhotite and pyrite.

C.C. Huston and Associates conducted a reconnaissance airborne magnetic survey and in December, 1969 staked nine claims over the central part of Carling Lake. A magnetometer survey (scale 1 inch to 400 feet or 1:4,800) and an induced polarization survey (scale 1 inch to 400 feet or 1:4,800) were completed. The magnetic survey results proved to be rather featureless and showed no correlation to the IP survey which did pick up one anomalous zone.

In 1971 the Noranda Exploration Company Limited held a group of six claims near the south boundary of the map-area on the Marchington River just west of Schist Lake. This activity coincided with other work being done in the Savant Lake area at that time (Trusler 1974; Bond 1975; 1976). This ground was staked on the basis of results obtained by an aerial electromagnetic survey. A magnetic and electromagnetic survey (including vertical loop) were done on the above property (scale 1 inch to 400 feet or 1:4,800) and a single diamond drill hole 103.9 m (340 feet) encountered pyrrhotite and pyrite stringers 2.5 to 5.4 cm in width.

Hudson's Bay Oil and Gas Company Limited also undertook an extensive exploration program of the Savant Lake region from 1972 to 1974 and drilled one diamond drill hole within the English River Subprovince. The drill hole was situated 1 km (¾ mile) north of Moose Lake and intersected 65 percent pyrrhotite and 15 percent pyrite over 2.1 m (7 feet) of granitoid gneiss.

Wabigoon Subprovince
(Savant Lake "Greenstone" Belt)

Mineral exploration in the extreme southeast margin of the map-area within the Savant Lake "greenstone" belt has been documented recently by Bond (1975; 1976; *in prep.*) and by Trusler (1974). The discovery of the Mattabi Mine on nearby Sturgeon Lake in 1968 has served to reactivate mining interest in the Savant Lake area from 1969 to 1974.

The main companies active in the areas covered by recent detailed mapping include Pershland Gold Mines Limited and The Algoma Steel Corporation Limited (Bond 1975, p.131-137), John Donner of Bird River Mines Company Limited (Bond 1976, p.129-135), the Canadian Nickel Company Limited (Bond 1975, p.142-144; Bond 1976, p.126-128; Trusler 1974, p.42), Canex Aerial Exploration Limited-Black Giant Mines Limited (Bond *in prep.*) and Noranda Exploration Company Limited (Bond 1974, p.146-148; Bond 1975, p.155-162; Bond *in prep.*; Trusler 1974, p.42-43). The most important of the above groups is the work done by Pershland Gold Mines Limited and The Algoma Steel Corporation Limited on the Kashaweogama Lake iron prospect (Shklanka 1968, p.396).

Mining comcerns within the Savant Lake "greenstone" belt that have not been documented to date occur predominantly in the mafic metavolcanic sequence situated north and west of McCubbin Township.

Beginning in 1956 Northern Canada Mines Limited has conducted extensive exploration work on the northern Kashaweogama iron prospect (Shklanka 1968, p.443-444). The prospect consists essentially of two separate, curvilinear southeast- to northeast-trending bands of magnetite-quartz iron-formation which have a strike length of 5 km (3 miles). In 1958 Northern Canada Mines Limited tested the zone with 11 diamond drill holes (1550 m or 5,100 feet) and in 1961 conducted a magnetometer survey followed by a geological survey (scale 1 inch to 200 feet or 1:2,400) of the 31-claim property. The former survey was done on a 120 m (400 feet) grid system of cut lines with a station interval of 30 m (100 feet). Both of these surveys indicated the iron formation bands to be between 15 and 120 m (50 and 400 feet) thick and from 150 to 240 m (500 to 800 feet) apart. The iron formation is associated with the base of a fairly thick mafic metavolcanic sequence. The property was optioned to The Hanna Mining Company Limited who conducted further magnetic surveys and geological mapping (scale 1 inch to 100 feet or 1:1,200) of the zones and from 1966 to 1967 drilled six diamond drill holes (535.5 m or 1,757 feet). Stringers of pyrrhotite with minor chalcopyrite were found in this drill core and as a result, a further electromagnetic (horizontal loop) survey was done (scale 1 inch to 400 feet or 1:4,800). The magnetometer survey indicated that the two main bands are made up of distinct lenses or pods of iron formation. According to Shklanka (1968) the prospect is estimated to contain 405,000 tons per vertical foot in four zones grading 28 percent Fe which can be concentrated to 65 percent Fe with 93 percent recovery on grinding to -325M.

Queenston Gold Mines Limited originally held 13 claims between Gayo and Fairchild Lakes and in 1958 drilled 16 diamond drill holes (599.8 m) on a single claim (PA22126 situated immediately north of the 7th base line). The holes intersected predominantly intermediate to mafic metavolcanics with pyrite, pyrrhotite and chalcopyrite mineralization associated with silicified intermediate to mafic metavolcanics and quartz veins ranging in width from 0.6 to 17.6 cm. The claims were allowed to lapse and B.B.M. Investments acquired the property in 1971.

Falconbridge Nickel Mines Limited staked 16 claims over an ultramafic body delimited by Hudec (1965) on the south side of Armit Lake. In 1965 the company conducted magnetometer and vertical loop surveys over the property in the hope of delineating further ultramafic bodies. The vertical loop survey did not pick up any conductive zones but several magnetic anomalous zones that were thought to be due to iron formation were encountered.

Hudson's Bay Oil and Gas Company Limited, in conjunction with their 1972 to 1973 exploration program in this area, drilled four diamond drill holes (195.4 m or 641 feet) just west of Highway 599 near the centre of the unsurveyed township directly north of McCubbin Township. These holes intersected predominantly gabbro, mafic- to intermediate metavolcanics, siltstone, quartzite, graphite and iron formation.

The Canadian Nickel Company Limited, also in conjunction with their 1967-1970 exploration program drilled eleven diamond drill holes (841.5 m or 2,760 feet) in the same unsurveyed township. Four of the holes were situated just south of Solitude Lake and the remaining seven holes were put down just east of Highway 599 and 1.5 km (1 mile) north of McCubbin Township.

GENERAL GEOLOGY

The map-area is situated within the Superior Province of the Canadian Precambrian Shield and includes portions of three structural-lithological subprovinces. About 90 percent of the map-area is underlain by the English River Subprovince which is bounded along the north by the Uchi Subprovince and in the southeastern corner by the Savant Lake metavolcanic-metasedimentary belt of the Wabigoon Subprovince. The general two-fold lithological division of the English River Subprovince established during 1974 and 1975 in the adjoining map-areas to the west was again found to be present in the Miniss-Tully Lakes area. Metasediments and their migmatitic counterparts occupy the northern portion of the English River Subprovince whilst granitic intrusive and gneissic plutonic rocks constitute the dominant lithologies in the southern domain.

Uchi Subprovince

The eastern extension of this Subprovince, i.e. the Doran Lake area was previously mapped by Goodwin (1965) and consequently only brief alteration was focused on this portion of the map-area in order to correlate map units.

LAKE ST. JOSEPH METAVOLCANIC-METASEDIMENTARY BELT

The western portion of the Lake St. Joseph area was previously investigated by Bruce (1922c) and, more recently, by Clifford (1969) and Clifford and McNutt (1971).

Immediately east from the entrance of Johnston Bay, Clifford (1969, Map 2159), Clifford and McNutt (1971, p.152) delineated a large southeast-trending metadiorite pluton. Examination of all available exposures along the western and northern shorelines of an unnamed bay containing Islands 70 and 81 revealed a volcanic succession composed of massive, medium-grained and fine-grained, pillowed mafic flows, dacitic tuff to lapillistone (with lesser tuff-breccia and pyroclastic breccia), and a 1.5 m (5 feet) band of magnetite-siltstone iron formation. Plutonic rocks are actually restricted to the extreme southeastern portion of the pluton as outlined by Clifford (1969). The major plutonic rock types consist of metamorphosed massive to weakly foliated biotite-amphibole diorite to quartz diorite and ancillary amounts of highly xenolithic biotite trondhjemite. A unit formerly mapped as boulder conglomerate (Clifford 1969; Clifford and McNutt 1971) at the base of a narrow band of argillite-wacke metasediments lying along the western to northern flanks of the dioritic pluton has been designated on the basis of current mapping as a pseudoconglomerate, the product of moderate to extreme boudinization of apophyses of diorite and trondhjemite satellite to the main mass. Immediately south of the aforementioned dioritic trondhjemitic mass, a previously undocumented layered mafic sill was encountered, being mainly exposed on Island 58. Predominantly this intrusion consists of medium- to coarse-grained equigranular to clotty metagabbro, alternating locally with layers of gabbroic anorthosite and anorthositic gabbro. The position of emplacement within a pillowed mafic metavolcanic sequence appears to have been controlled by a synclinal fold axial surface. This body is currently the subject of B.Sc. thesis research by D. Smith of Queen's University.

An impressive felsic to intermediate pyroclastic centre was accurately delineated by Clifford (1969, Map 2158 and 2159). Unfortunately much of this mass lies beneath waters of Lake St. Joseph. On a group of islands just west of Eagle Island, coarse generally monolithologic pyroclastic breccia and tuff-breccia of dacitic composition are prominent and quite often exhibit bedding with tuff and lapilli-tuff of similar composition. Thin layers of mafic tuff are also discernable within this pile. The direction of stretching of fragments is prevailingly normal to bedding.

PAPAONGA LAKE-ROADHOUSE RIVER-ROOT BAY METAVOLCANIC BELT

The supracrustal sequence at Lake St. Joseph extends westward to join up with the metavolcanic-metasedimentary sequence in the Papaonga Lake area (Breaks *et al.* 1975, p.25). Part of this extension was also mapped by Clifford (1969). Stratigraphic relations within this sequence are grossly similar to those in the Papaonga Lake area: the majority of the sequence is composed of fine- to medium-grained mafic metavolcanic flows. These flows are flanked to the south and north by thin, fine-grained pyroclastic, in part metasedimentary, units. Along the southern margin the pyroclastic rocks form a continuous marker horizon while those in the north appear to form discontinuous lenses. Towards the Lake St. Joseph area the southern pyroclastic unit becomes more metasedimentary in character with thin beds of metagreywacke and metasiltstone interrupted by arkosic and/or reworked felsic tuffaceous horizons. No primary top indicators were found to aid in stratigraphic determinations within this sequence.

North of the supracrustal rocks, mainly granitoid plutonic rocks are exposed. In the extreme northeast part of the map-area a massive unmetamorphosed batholith of quartz monzonite, which is continuous from the previous map-area (Breaks *et al.* 1975), extends eastward for approximately 11 km (7 miles) at which point it begins to interfinger with a batholith of finer grained, weakly foliated metatrondhjemite. The extensive pegmatite border phase observed to mantle this quartz monzonite batholith north of Papaonga Lake (Breaks *et al.* 1975, p.26) was not encountered in the present map-area although the spodumene-bearing pegmatite, situated just north of the Roadhouse River and documented previously in this report, is undoubtedly related to and is a discontinuous extension of this same pegmatite zone. A heretofore unmentioned pegmatite lens was also found approximately 10 km (6 miles) NNE of the Roadhouse River pegmatite and is also probably a satellite body related to the main pegmatite zone. No economically significant mineralization was discerned in this latter zone. Adjoining the above-described batholith, is another batholith which Clifford (1969, p.35) referred to as the "Bamaji-Blackstone Granite". This batholith is primarily massive, unmetamorphosed, medium-grained trondhjemite to granodiorite in which quartz typically forms subhedral to euhedral crystals. The quartz is elongated in a weakly cataclastic fabric near the margins of this batholith. The western boundary of the batholith is in contact with a thin northeast-trending lobe of metavolcanics also mapped by Clifford (1969) on Dalgas Lake.

English River Subprovince

Previous reconnaissance mapping by Wright (1936), Dyer (1933), and Bruce (1922a,b,c) covered portions of the northern supracrustal terrain of the English River Subprovince. Williamson and Hudec (1959), and Hudec (1965) respectively covered the southeast corner and 2850 km^2 (1,100 square miles) in the Highston Lake-Miniss Lake area. Skinner (1969) directed a reconnaissance survey completely covering the present map-area at a published scale of 1 inch to 4 miles (1:253,440). Recent detailed mapping by Goodwin (1965) and Clifford (1969) focused upon Uchi Subprovince supracrustal rocks and the adjoining northern porphyry of the English River Subprovince.

NORTHERN SUPRACRUSTAL DOMAIN

Mapping by recent helicopter-supported geological reconnaissance surveys in the English River Subprovince (Sage *et al.* 1974; Breaks *et al.* 1974; 1975) including the Miniss-Tully Lakes area has established presence of a continuous, relict supracrustal belt, composed of overwhelmingly clastic metasediments distributed over a 400 km (250 mile) strike length. Width of the belt is quite variable, ranging from 1.5 to 51 km (1 to 32 miles) and averaging about 30 km (20 miles). An overall strike length of about 1200 km (750 miles) may be postulated for the northern metasedimentary migmatite domain. This length would include the correlative Manigotagan gneisses of Manitoba (McRitchie and Weber 1971) and rocks to the east of Longitude 89°00′ (Thurston and Carter 1970), and assumes continuance at least to the Kapuskasing Structure. This belt represents a vast geosynclinal basin primarily infilled with clastic material; the wackes and mudstones formed from this accumulation were pervasively migmatized during the Kenoran tectonic-metamorphic event at about 2681±20 m.y. as recently dated by Krogh *et al.* (1976). Pronounced narrowing of this metasedimentary migmatite belt is evident in the Miniss Lake-Medcalf Lake area, primarily engendered by intersection of two cataclastic zones, viz. the northeast-striking Miniss River Fault Zone[1] and a less prominent fault zone extending westerly from Medcalf Lake towards Dawson and Trist Lakes. Displacement on both fault systems was mainly horizontal strike-slip as evidenced by ubiquitous 'A' lineations. Right-hand sense of movement is common to both fault systems. With respect to the better exposed Miniss River Fault zone, the strike-slip component of displacement is estimated to be at least 10 km (6 miles), based upon assumed off-setting relations between a biotite-hornblende trondhjemite to quartz diorite on the northwestern side of fault zone and a dioritic mass occurring along the southeastern side. It is estimated that the predominant granitic/gneissic terrain occupying the area between the Savant Lake belt and southeastern side of the Miniss River Fault Zone has been uplifted.

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[1] Named by Hudec (1965) and later called Manitou-Dinorwic Fault Zone by Skinner (1969). The publication of Hudec takes chronological precedence.

Within the metasedimentary migmatite domain itself, a further broad subdivision can be recognized, based upon dominance of particular migmatitic stage. A zone of metatexite prevails immediately south of the Uchi Subprovince metavolcanic terrain between the west side of the Otatakan Lake area and Medcalf Lake. Roughly along Latitude 49°48′, between the western boundary of the map-area and the Miniss River Fault Zone, the metatexites imperceptibly grade southwards into an extensive zone of inhomogeneous and homogeneous diatexite. This voluminous quantity of mobilizate, estimated to be at least 3890 km^2 (1,500 square miles) in area, tapers gradually from the western map-area boundary between Fir Lake and Lac Seul towards St. Raphael and Arc Lakes. Local screens of metatexite are apparent within this extensive mobilizate-rich regime and become more voluminous near the southern part of the metasedimentary domains in the vicinity of Lac Seul just north of Chamberlain Narrows. In the southwest part of the map-area between Carling Lake and Lac Seul the trend of these advanced stage metasedimentary migmatites is often contorted, having been influenced by the intrusion of numerous granitoid stocks. Both metamorphosed and unmetamorphosed granitoid stocks are represented and compositions range from trondhjemite to quartz monzonite. Contact of the metasedimentary migmatitic rocks with the granitic-gneissic terrain of the southern portion of English River Subprovince is also highly scalloped and serrated by granitic stocks and batholiths. Late to post-tectonic quartz monzonite stocks and dikes have extensively invaded the diatexite mass between Arc and Carling Lakes. Post-tectonic dikes of quartz monzonite cross-cutting the diatexite thus constitute the youngest igneous phase observed within the map-area. In the Carling-Tully Lakes area, stocks and batholiths of older, foliated, well recrystallized biotite and hornblende-biotite trondhjemite are distributed along the southern contact zone in addition to being enclosed within the diatexite mass itself.

Northern boundary relations between the English River Subprovince and adjoining Uchi Subprovince appears to represent a simple transition from an island-arc volcanic environment into a quasi-contemporaneous geosynclinal trough. This association as exemplified by the western Lake St. Joseph area is in part complicated by several deformation events and regional metamorphism. The actual boundary zone has been the locus of considerable north-south flattening as evidenced by generation of isoclinal macroscopic folds and moderate to intense buckling of discordant (to bedding) mafic and granitic dikes contained within pelitic-psammitic metasediments.

This boundary has also been influenced by a late brittle deformation event, forming the Lake St. Joseph Fault Zone[1], which is traceable for approximately 55 km (35 miles) near the southern shoreline of Lake St. Joseph from just south of Eagle Island west to Root Lake area.

This high-level fault is known to extend a further 19 km (12 miles) to the west but due to poor accessibility has not been accurately delimited. It probably extends further west to link up with a zone of cataclastic metavolcanics situated 6 km (4 miles) east of Papaonga Lake and mapped during the 1975 field season. Pseudotachylite is ubiquitous within the main fault zone in lithologies of favourable composition (i.e. wackes and arkoses). In addition, pseudotachylite occurs along related thin shears at distances of up to 1.9 km (1.2 miles) from the main zone.

SOUTHERN GRANITOID INTRUSIVE GNEISSIC DOMAIN

The characteristically plutonic nature of the southern domain of the English River Subprovince, previously established (Breaks *et al.* 1974; 1975), was found to continue in the present map-area. Within the Miniss-Tully Lakes area this plutonic domain is situated approximately south of a line extending from Medcalf Lake in the northeast to Highball Lake in the south and northwest to Chamberlain Narrows (on Lac Seul) in the west. Three major age groups are again discernible on the basis of field relations and internal deformation.

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[1] Named by Skinner (1969).

Fairly well banded to foliated granitoid gneissic rocks are distributed sporadically as isolated lenses, and in one place at the northeast part of De Lesseps Lake as a dome-like structure, and are the most severely deformed rocks. The gneissic fabric in the rocks is thought to be generated largely by the intimate mixing resulting from multiple intrusive phases and associated mafic (volcanic?) xenoliths. These rocks are essentially trondhjemitic to granodioritic in composition. These gneissic rocks commonly grade imperceptibly into foliated, recrystallized granitoid intrusive batholiths of trondhjemitic to granodioritic to locally quartz dioritic composition. The latter rock type forms the greater bulk of the southern plutonic domain. The third and least deformed group forms discrete batholiths and stocks of massive to porphyritic, granitoid rocks ranging from sodic-rich to potassic-rich varieties.

The regional strike of foliation and banding in the first two groups is generally northeast but in local areas this has been modified by the younger, undeformed intrusions.

Wabigoon Subprovince

SAVANT LAKE METAVOLCANIC-METASEDIMENTARY BELT

Relatively brief attention was directed towards this segment of the map-area because it was previously mapped in detail by Bond (1974; 1975; 1976) and Trusler (1975). Emphasis was placed upon those areas previously untouched by the detailed work in order to correlate and trace lithologic units.

The compilation by Davies *et al.* (1970) on the portion of the Savant Lake belt lying to the north of Kashaweogama Lake and Wiggle Creek is reasonably accurate and only minor modifications were made there. North and west of McCubbin Township the mafic metavolcanic sequence forms a synclinal sequence opening to the east with the axis of folding trending in a nearly east direction and plunging steeply to the southeast. The mafic metavolcanics are composed predominantly of massive and pillowed flows. A zone of iron formation lies near the base of this sequence. According to company reports (Assessment Files Research Office, Ontario Division Mines, Toronto File 63.2115) the iron formation beds are of considerable continuity and can be traced for approximately 6 km (4 miles). Most of the individual beds are less than 6 m (20 feet) thick but a maximum of 120 m (400 feet) is reached in one area. The magnetite content varies from approximately 10 to over 30 percent with the remainder being composed of chert and iron silicate minerals. According to the above assessment file (63.2115):

> The banding is often highly crenulated and contorted and in general gives the impression that it absorbed much of the movement during folding. Narrow sills and dikes of amphibolitized basic rock cut the iron formation.

The iron formation is fairly lean especially in the northern extension. Locally, beds of tuff are found below and associated with the iron formation but are exceedingly rare above the iron formation. This lean iron formation is probably continuous with the iron silicate formation found to extend northwest of (near the west end of) Kashaweogama Lake (Bond 1974). The latter iron formation is also situated in mafic metavolcanics and has been traced northwest to the southern end of Armit Lake.

The Savant Lake conglomerate which is exposed in McCubbin Township (Bond 1975) was traced along the north shore of Kashaweogama Lake and linked with the conglomerate exposed in the Hough-Houghton Lakes area (Bond 1974).

Davies *et al.* (1970) accurately delimited the mafic volcanic belt extending from Kashaweogama Lake to Winsom Lake. The present mapping indicates that the belt is predominantly composed of mafic metavolcanics but towards the southwest a zone of felsic tuffs and minor metasedimentary units were also found. A felsite body approximately 1.5 km (1 mile) across was found on the north shore of Kashaweogama Lake near this same mafic volcanic lobe and may represent the volcanic source of these felsic tuffs.

Separate granitic stocks north of Wiggle Creek and just south of Fitchie Lake are present as shown on the regional compilation by Davies *et al.* (1970). The granitoid lobes extending into the Savant Lake "greenstone" belt at Dickson Lake and Curlew Lakes (Heron Lake Stock) are also separate, relatively uniform, granitoid stocks that are substantially different in character from the more highly deformed granitoid plutonic rocks of the southern part of the English River Subprovince with which they are in contact. The latter stock (Curlew-Heron

Lakes) is the subject of investigation of a B.Sc. thesis research by R. Kusminski of McMaster University. The contact between the Savant Lake "greenstone" belt and the English River Subprovince is marked only by granitic intrusion.

ECONOMIC GEOLOGY

Uchi Subprovince

Attention should be directed towards investigation of the coarse felsic to intermediate pyroclastic mass in the western Lake St. Joseph area. Despite its potential importance as a host for massive volcanogenic sulphide mineralization, no documented mineral exploration programs testing this possibility have yet appeared in the assessment files of the Ontario Division of Mines. One occurrence of sulphide mineralization was encountered by the present survey on Island 17 near the southeast extremity of Eagle Island. Heavily limonitic bedded chert, pyritic chert, argillite, and intraformational chert breccia lie exposed in contact with felsic to intermediate tuff, lapilli-tuff, and local interbedded pyroclastic breccia. This horizon may be of exhalite origin and could harbour important economic mineralization.

English River Subprovince

Future mineral exploration programs concerned with the northern supracrustal domain of the English River Subprovince should focus upon the potential of uranium mineralization and Li-Ta-Cs-Be-bearing pegmatitic deposits as previously elaborated by Breaks *et al.* (1975, p.31-32) for Operation Kenora-Ear Falls. No uraniferous occurrences have yet been discovered within this region of the English River Subprovince. Lithium mineralization at Roadhouse River appears related to intrusion of highly mobile, late residual diatexitic liquids into a narrow metavolcanic sequence extending between Papaonga Lake and Lake St. Joseph. Substantial masses of diatexite are situated adjacent to this occurrence within the northern supracrustal domain and may merit intensive geological investigation for further lithium mineralization, possibly accompanied by Ta and Cs.

Wabigoon Subprovince

Mineralized zones were found to be exceedingly rare throughout most of the map-area. A few old test pits found along Kashaweogama Lake are the only mineralized zones detected which have not been reported by any of the previous workers.

Associated with the felsite body on the northwest shore in the central portion of Kashaweogama Lake there is a zone of sulphide-bearing quartz veins and associated silicified rocks. The sulphide zone is slightly discordant to the foliation of the felsite host rock which strikes N85W and dips near vertical. The sulphide zone strikes N80E, dips vertically, is 2.4 m (8 feet) wide and is traceable for 45 m (150 feet). Much stripping and four test pits have been excavated but there is no record of this work in the regional assessment files. Predominantly subhedral to euhedral pyrite is disseminated (up to 30 percent) in bands and in veinlets and is the only visible mineralization. A selected sample of the pyritic zone when assayed by the Mineral Research Branch, Ontario Division of Mines, indicated 0.01 ounces of gold per ton, 0.02 percent copper and 0.02 percent lead.

Just west of this felsite body, at the contact of the metaconglomerate and mafic metavolcanics on the north shore of Kashaweogama Lake, several test pits have been blasted in a major shear zone (i.e.: Kashaweogama Lake Fault, Bond 1974; 1975). The intensely sheared conglomeratic rocks are highly carbonatized and injected locally by mineralized quartz veins. Pyrite plus a green mineral that is probably fuchsite constitute the only visible mineralization observed in the field.

South of Kashaweogama Lake, the area is underlain by a sequence of intercalated metavolcanics and metasediments that are typical of a standard upper volcanic cycle, and this portion of the Savant Lake "greenstone" belt warrants further investigation for its base metal potential. A band composed predominantly of felsic to intermediate, fine to coarse pyroclastic rocks situated north of Whimbrel Lake in McCubbin and Poisson Townships has received little attention from exploration companies to date and also warrants further exploration for its economic potential. It is the author's belief that this latter felsic sequence is chemically related to the extensive Jutten mafic metavolcanic sequence exposed in the northwest part of McCubbin Township and in the area southeast of Savant Lake. Most of that portion of the Savant Lake "greenstone" belt previously unmapped was found to be composed of mafic metavolcanic flows and, except for the small pyroxenite body on the south end of Armit Lake, would appear to be economically less important than the above two felsic to intermediate sequences.

The two major iron prospects, north Kashaweogama Lake prospect (Shklanka 1968, p.396) and north Kashaweogama prospect (Shklanka 1968, p.443), are both economically interesting although the former seems to have the most potential.

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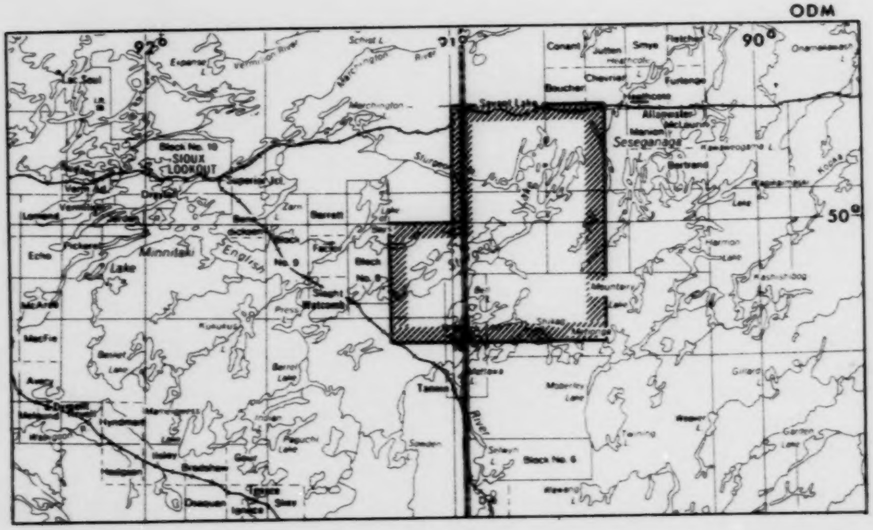
NO. 5 STURGEON LAKE SYNOPTIC PROJECT

DISTRICTS OF THUNDER BAY AND KENORA

N.F. Trowell[1]



LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

LOCATION

The area is bounded as shown on the location map and is centred about 77 km (48 miles) east of Sioux Lookout. Highway 599 extends through the western portion of the area from Ignace, and provides access to Sturgeon Lake. The rest of the area is accessible by recently constructed lumber roads and by float-equipped aircraft.

MINERAL EXPLORATION

Past mineral exploration in the area has been described by Trowell (1968; 1969; 1970a; 1971; 1972; 1973; 1974c; 1975).

GENERAL GEOLOGY

The area is underlain by an Early Precambrian (Archean) sequence of metavolcanics, metasediments, and intrusive rocks forming part of the Wabigoon (Goodwin 1970) Belt in the Superior Province of the Canadian Shield. The metavolcanics and metasediments have been grouped by the author into three assemblages: the South Sturgeon Assemblage, the North Sturgeon Assemblage and the Northeast Arm Assemblage. Additional information on the South Sturgeon Assemblage has been obtained from Covello (1971), Franklin (1975; 1976), Shegelski (1975; 1976), and Shegelski and Bell (1976) while detailed information on the chemistry of the North Sturgeon Assemblage was obtained from Beggs (1975).

More detailed work has commenced on the chemistry of the several metavolcanic cycles and the author expects that some of the units previously mapped as intermediate to locally felsic in composition will be relegated to an intermediate to locally mafic composition.

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South Sturgeon Assemblage

The South Sturgeon Assemblage appears to consist of, in ascending order, five cycles: 1) the Darkwater Lake cycle, 2) the Claw Lake cycle, 3) the Lyon Lake cycle, 4) the South Shore cycle, and 5) the Sturgeon cycle.

The Darkwater Lake cycle comprises: (a) a basal sequence of mafic volcanic massive flows, pillowed flows, minor tuffs, and thin interflow, locally ferruginous, wacke-siltstone beds, succeeded by (b) a sequence of intermediate volcanic clastic rocks of pyroclastic, reworked pyroclastic (subaqueous ash flows, proximal debris flows, possible lahars (Franklin 1976) and possibly of hyaloclastic and autoclastic origin; this sequence also contains thin, intercalated, mafic to intermediate volcanic flows; and (c) an upper sequence of felsic pyroclastic and reworked pyroclastic rocks and volcanogenic chert and tuffite units. The Mattabi Mines Limited Zn-Cu-Ag-Pb sulphide deposit (Franklin *et al.* 1973; 1975; Kasarda 1973) lies within felsic metavolcanics just below the top of this cycle. The Beidelman Bay Pluton (Trowell 1974a; Friske 1974; Franklin 1975) present within this cycle is possibly of subvolcanic origin (porphyry copper affinities) and may be genetically as well as spatially related to both the intermediate and felsic volcanic clastic rocks and their contained massive, sulphide-mineral deposits.

The Claw Lake cycle consists of (a) a basal sequence of andesitic massive flows, pillowed and amygdaloidal flows, and autoclastic (pillow breccia) zones, overlain by (b) felsic to intermediate sodic (Franklin 1975) volcanic clastic, predominantly pyroclastic rocks, and (c) an upper sequence of volcanogenic metasedimentary, locally graphitic, wacke-siltstone units. The Lyon Lake, Creek, and Boundary massive sulphide deposits occur at the top of the Claw Lake cycle (Franklin 1975).

The Lyon Lake cycle consists of (a) a basal sequence of mafic flows and tuffs, succeeded in turn by (b) a felsic pyroclastic, potassic (Franklin 1975) unit, (c) intercalated mafic to intermediate flows and felsic pyroclastic rocks, and (d) an upper sequence of wacke-siltstone, pebbly wacke, and graphitic sulphide bands (Nielsen 1974).

The South Shore cycle consists of (a) a basal sequence of mafic massive flows, pillowed flows, and tuffs, overlain by (b) a felsic, volcanic clastic, breccia unit with thin interbeds of wacke-siltstone and graphitic sulphide, in turn overlain locally (?) by (c) an upper unit of mafic massive flows, pillowed flows, and tuffs, and (d) an upper, clastic metasedimentary sequence (Shegelski 1975; 1976; Shegelski and Bell 1976) of volcanic clastic breccia, conglomerate, quartz-magnetite iron formation and wacke-siltstone.

The Sturgeon cycle consists of (a) mafic massive flows, pillowed and amygdaloidal flows, and autoclastic breccia units overlain by (b) minor, and only locally present, intermediate volcanic clastic rocks. The Sturgeon cycle is characterized by the presence of ultramafic, serpentinitized peridotite intrusions.

North Sturgeon Assemblage

The North Sturgeon Assemblage appears to consist of, in ascending order two major and one apparently partial cycle: 1) the Fourbay Lake cycle, 2) the Six Mile Lake cycle and 3) the North Shore cycle.

The Fourbay Lake cycle consists of (a) an apparently basal unit of mafic volcanogenic wacke and intercalated mafic tuffs and flows, succeeded by (b) a sequence of mafic massive flows, pillowed and amygdaloidal flows, porphyritic and porphyritic pillowed flows, and substantial thicknesses of interflow, locally ferruginous, wacke-siltstone, and (c) an upper sequence of intermediate volcanic clastic rocks of possible subaqueous ash flow origin.

The Six Mile Lake cycle consists of (a) a basal sequence of mafic massive flows, pillowed and amygdaloidal flows, and minor hyaloclastites, overlain by (b) an intermediate, volcanic clastic sequence of autoclastic, pyroclastic, and reworked pyroclastic rocks variable locally to volcanogenic metasediments.

The North Shore cycle consists of mafic flows, pillowed and amygdaloidal flows, autoclastic breccia zones and thin hyaloclastite units.

Northeast Arm Assemblage

The Northeast Arm Assemblage appears to consist of three cycles: 1) the North Arm cycle, 2) the Morgan Island cycle and 3) the Squaw Lake cycle.

The North Arm cycle consists of (a) a basal unit of mafic massive flows, pillowed flows, porphyritic and porphyritic pillowed flows, minor tuffs, and thin interflow, locally graphitic and ferruginous, volcanogenic wacke-siltstone beds, overlain by (b) mafic to intermediate flows, pillowed and amygdaloidal flows, and autoclastic breccia zones and tuffs, (c) intermediate volcanic clastic rocks with thin intercalated mafic to intermediate flows, and (d) felsic volcanic clastic rocks at the top.

The Morgan Island cycle consists of: (a) a basal unit of hyaloclastite (Gordanier 1975) and mafic pillowed and amygdaloidal flows, succeeded by (b) intermediate to locally felsic volcanic clastic rocks of reworked pyroclastic and volcanogenic epiclastic origin with minor felsic spherulitic flows or tuffs.

The Squaw Lake cycle consists of: (a) a basal sequence of mafic massive flows, pillowed and amygdaloidal flows, tuffs, and thin interflow beds of locally ferruginous, wacke-siltstone, and (b) a clastic sequence of volcanic clastic breccia, conglomerate, wacke-siltstone, and thin sulphide bearing locally graphitic units.

STRUCTURAL GEOLOGY

Additional structural information was collected and the author hopes to do a computer-assisted structural analysis of the area in the near future. The analysis should assist in determining the structural domains present within the area.

ECONOMIC GEOLOGY

A principal objective of this chemical and stratigraphic study is to interpret the genesis of the mineral deposits of the present area, and thereby to provide guidelines for evaluating other metavolcanic-metasedimentary sequences for economic mineral deposits.

The reader is referred to Trowell (1968; 1969; 1970a; 1970b; 1971; 1972; 1973; 1974a; 1974b; 1974c; 1975) for previous descriptions of the economic geology of the area.

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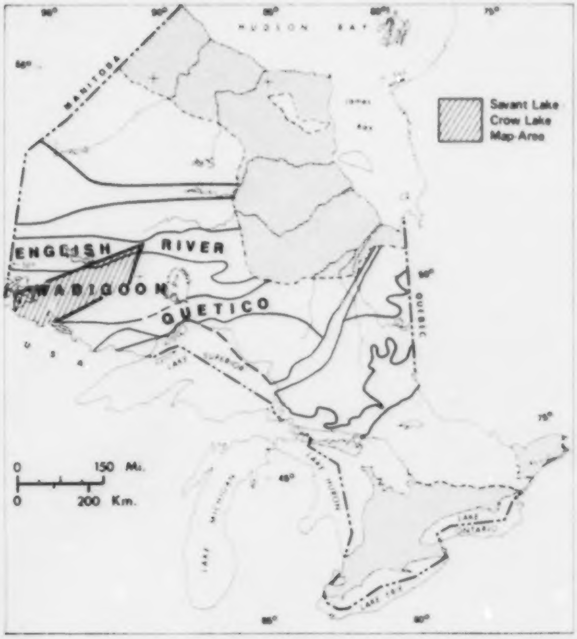
NO. 6 SAVANT LAKE-CROW LAKE SPECIAL PROJECT

DISTRICTS OF THUNDER BAY AND KENORA

N.F. Trowell[1] and C.E. Blackburn[1]


HUDSON BAY
MANITOBA
QUEBEC
Savant Lake
Crow Lake
Map-Area
ENGLISH RIVER
WABIGOON
QUETICO
LAKE SUPERIOR
LAKE HURON
LAKE MICHIGAN
LAKE ONTARIO
LAKE ERIE
0 150 Mi.
0 200 Km.

In 1976, N.F. Trowell and C.E. Blackburn began a joint project involving a regional study of the stratigraphy, structure, and economic geology of the metavolcanic-metasedimentary belts between Savant Lake and Crow Lake.

The authors are presently involved in synoptic projects in the Sturgeon Lake and Manitou Lakes areas, repectively (*described in this volume*). Extension of the stratigraphic and structural relationships determined in these areas into the rest of the project area will involve both compilation of past geological work in the area and selective field mapping by the authors.

The aims of this project are to gain a better understanding of the petrogenetic and structural evolution of this portion of the Wabigoon Belt (Mackasey *et al.* 1974) and to determine, more clearly, the interrelationships of geological environment and mineral deposits within this area.

REFERENCE

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1974: A Regional Approach to the Wabigoon-Quetico Belts and its Bearing on Exploration in Northwestern Ontario; Ontario Div. Mines, MP58, 30p.

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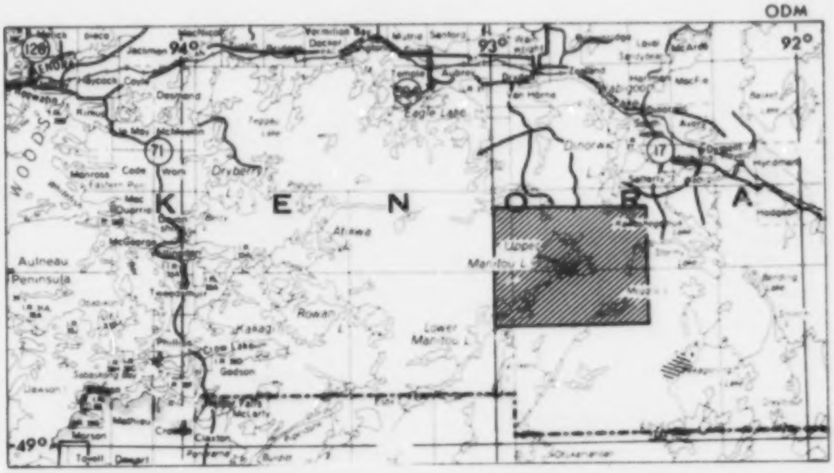
[1] Geologist, Precambrian Geology Section, Geological Branch, Ontario Division of Mines, Parliament Buildings, Toronto.

NO. 7 MANITOU LAKES SYNOPTIC PROJECT

DISTRICT OF KENORA

C.E. Blackburn[1]



LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

INTRODUCTION

As a follow-up to a four-year programme of detailed mapping in the general vicinity of the Manitou Lakes (Blackburn 1974b; 1976b,c,d), a synoptic study was undertaken during the 1976 field season, with the intention of elucidating remaining stratigraphic and structural problems, and of carrying out further detailed work in key localities.

A Geoscience Report and accompanying synoptic geological map at a scale of 1:50,000 of the Manitou Lakes area will be published.

LOCATION

The Manitou Lakes area is bounded by Latitudes 49°15′ and 49°30′N and by Longitudes 92°30′ and 93°00′W, and covers approximately 1040 km^2 (400 square miles). Access may be gained to the area via logging roads extending southward, both from the town of Dryden, and from Highway 17 east of Dinorwic Lake. A provincial highway presently under construction, linking Dryden with Highway 11 east of Rainy Lake, will pass through the eastern part of the area. The former town of Gold Rock is located in the north central part of the area.

MINERAL EXPLORATION

Past mineral exploration in the area has previously been described by the author (Blackburn 1972; 1973; 1974b; 1975). New activity in the area in 1976 included ground electromagnetic work by Selco Mining Corporation Limited, at Boyer Lake, and reconnaissance geology and sampling by Gulf Minerals Canada Limited at Upper Manitou Lake.

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[1] Geologist, Precambrian Geology Section, Geological Branch, Ontario Division of Mines, Parliament Buildings, Toronto.

GENERAL GEOLOGY

The map-area straddles the Manitou-Stormy Lakes metavolcanic-metasedimentary belt in the Wabigoon Belt (Mackasey *et al.* 1974). The Manitou-Stormy Lakes belt, previously mapped by Thomson (1933), is part of a complex of interconnected belts for which the details of stratigraphic relationships, both within and between each other have not yet been fully elucidated.

The recent detailed geological mapping (Blackburn 1974b; 1976b,c,d) in the Manitou Lakes portion of the belt has shown that at Upper Manitou Lake a lower, 6000 m (19,000 feet) thick sequence of tholeiitic mafic flows overlain by calc-alkaline intermediate and felsic pyroclastic rocks, with minor associated metasediments, is conformably overlain by an upper sequence, in excess of 5500 m (18,000 feet) thick, of tholeiitic and calc-alkaline mafic flows and mafic to intermediate pyroclastic rocks, with minor felsic metavolcanics.

Southeast of a major structural break, the Manitou Straits Fault, a 11 300 m (37,000 feet) sequence of tholeiitic mafic flows overlain by calc-alkaline intermediate and felsic pyroclastics and flows, with abundant associated metasediments, is correlated with the lower sequence at Upper Manitou Lake. This lower sequence southeast of the Manitou Straits Fault is overlain with marked angular discordance, at Mosher Bay and at Washeibemaga Lake, by a monotonous sequence, in excess of 4500 m (15,000 feet) thick, of tholeiitic mafic flows. Prior to the 1976 field season the author interpreted this second tholeiitic sequence to be the equivalent of the tholeiitic mafic flow portion of the lower sequence and to have been moved into position along a thrust fault, thus accounting for the angular discordance (Blackburn 1976a). However, further investigations at Mosher Bay suggest that the angular discordance is due to unconformity rather than faulting, so that this upper tholeiitic sequence, although markedly different from the upper sequence at Upper Manitou Lake, has now been correlated with it.

No further major changes in general geology have been found.

STRUCTURAL GEOLOGY

Major structural features as previously reported (Blackburn 1972; 1973; 1974a,b; 1975; 1976b,c,d) remain unchanged, apart from the removal from the map of the thrust-fault at Mosher Bay and Washeibemaga Lake (see "General Geology"), and a revision of the fold structure in the vicinity of Boyer and Washeibemaga Lakes. With reference to the latter, inspection of the Snake Bay road section, some 3 to 5 km (2 to 3 miles) east of the map-area, and of the shoreline at Aiabewatik Lake conclusively shows on the basis of excellent pillow tops that there is only one east-trending synclinal fold between the north end of Boyer Lake and Washeibemaga Lake, and that the fold axis lies 2 km (1.2 miles) north of Washeibemaga Lake.

ECONOMIC GEOLOGY

Detailed mapping at a scale of 1:12,000 (1 inch to 1,000 feet) of the former gold camp at Gold Rock, previously mapped at the same scale by Thomson (1938), has shown that gold mineralization at the Big Master, Laurentian and Jubilee Mines occurred in narrow felsite units and associated quartz veins that pinch and swell or are lensoid along strike. Some of these felsites were traced either continuously or discontinuously over distances in excess of 1000 m (3,200 feet). Over these distances, the felsite units are conformable to the stratigraphy of the mafic metavolcanics which consist of mappable feldspar-phyric flows and pillowed and brecciated flows. However, the sharp contacts of the felsite units suggest that they are intrusive, and they are interpreted to be shallow synvolcanic sills, rather than flows. One narrow quartz-feldspar porphyry unit, similar in composition to the felsites, was found to transgress the volcanic stratigraphy at a very shallow angle, and also to cut the felsite units, and is similarly interpreted to be a shallow sheet-like intrusion.

Detailed mapping at a scale of 1:1200 (1 inch to 100 feet) of a gold occurrence on the property of Pelham Gold Mines Limited, about 2 km (1.2 miles) west of the southern end of Washeibemaga Lake, has shown that the gold-bearing siliceous lenses and veins occur in gabbroic-textured mafic rocks. The gabbroic rocks are the interior part of a 240 m (800 feet) thick flow. The flow occurs in a sequence of alternating and lensoid massive and pillowed flow units with minor felsic flow and pyroclastic phases. At its top, this predominantly mafic sequence is intercalated with and overlain by felsic and intermediate crystal tuffs and agglomerates associated with the felsic subvolcanic porphyry at Thundercloud Lake.

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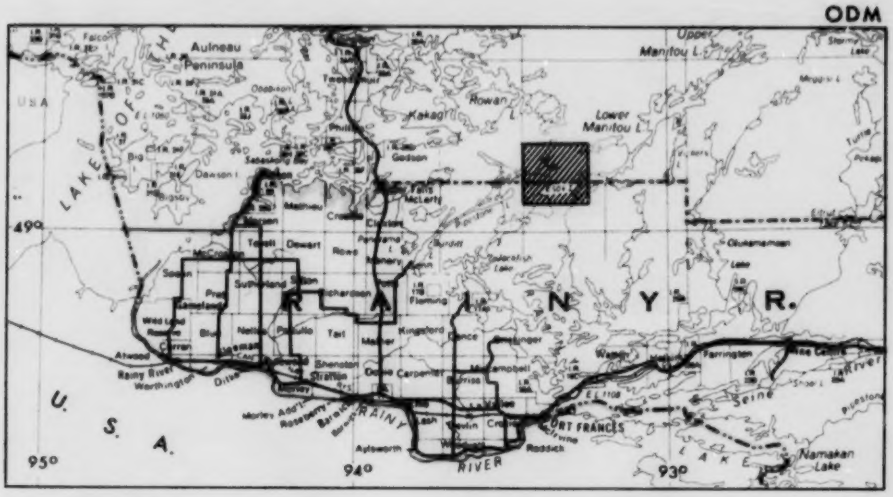
NO. 8 STRAW LAKE AREA

DISTRICTS OF RAINY RIVER AND KENORA

Garth Edwards[1]



LOCATION MAP

Scale: 1:1,584,000 cr 1 inch to 25 miles

LOCATION

The map-area is bounded by Latitudes 49°03.75′ and 49°11.25′N and Longitudes 93°15′ and 93°30′W, and is centred 40 km (25 miles) east of Nestor Falls, a small community located on Highway 71, midway between Kenora and Fort Frances. Although float-equipped aircraft were used for access, most of the area can be reached by canoe either from the southwest (Pipestone Lake), the south (Rainy Lake and Fort Frances) or from the northeast (the Manitou Lakes).

MINERAL EXPLORATION

Gold motivated prospecting in the area as early as the late 19th Century but significant finds were not made until 1933 (Thomson 1934) when gold was discovered at four locations on or near Straw Lake.

The *Konigson Occurrence* (Ferguson *et al.* 1971), discovered by E. Konigson in mineralized schistose, intermediate pyroclastic rocks on the north shore of Straw Lake, is a patented property (K2550). The first recorded examination of this property was in 1933 by W. Smith (Thomson 1934). Work on the claim consisted of thorough stripping, mapping and much trenching, and a shaft was sunk 12 m (40 feet) at the discovery sight. At least 336 m (1,119 feet) of diamond drilling was performed in six holes spaced 15 m (50 feet) apart along the suspected mineralized zone (information from the Regional Geologist's Files, Ontario Ministry of Natural Resources, Kenora).

The *Straw Lake Beach Mine* (past producer) was initially discovered by M. Mosher and F. Grozelle in 1933 (Thomson 1934) south of the northeast arm of Straw Lake. Gold here occurs mainly in a mineralized quartz vein in schistose felsic metavolcanics. Trenching, stripping and pitting was performed by Moneta Porcupine

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Mines Limited in 1933 and 1934. From 1934 to 1941 work performed by Straw Lake Beach Gold Mines Syndicate Limited included trenching, 11 surface diamond drill holes totalling 1074 m (3,579 feet), a shaft 220 m (723 feet) deep with levels at 100, 200, 300, 425, 575 and 700 feet, and a winze, 55 m (180 feet) east of the shaft, sunk from the 130 to 142 m (425 to the 465 feet) depth with a level at 142 m (465 feet). Total drifting and crosscutting were 1257 m (4,125 feet) and 154 m (506 feet) respectively. Production (1938 to 1941) was 11,568 ounces Au and 1,049 ounces Ag from 33,662 tons of ore. The shaft is located on patented claim K3944 (information from Ferguson *et al.* 1971). During the summer of 1976 geological mapping and diamond drilling was performed in the mine area for Projex Limited. The results of this exploration work are presently not known to the author.

The *Straw Lake Occurrence* was discovered south of Straw Lake by W. Lucy in a feldspar porphyry dike. In 1934 the Straw Lake Mining Syndicate carried out surface stripping and pitting on patented claims K4016 and K4017 (Thomson 1935). No records of diamond drilling were found by the author.

The *Viger Occurrence* located east of the southeast arm of Straw Lake on patented claims K4290, K4291, and K4292 was discovered by O. Viger about the same time as the other occurrences on Straw Lake. No records of exploration work except for copies of Assay Certificates (Regional Geologist's Files, Ontario Ministry of Natural Resources, Kenora) were found by the author.

Small quantities of gold were discovered north of Line Bay, Pipestone Lake in 1934 by C. Phinney and G. Sullivan and Sons and apparently by J. Prout on adjoining claims (Thomson 1935). Exploration appears to have been mainly stripping and trenching as no records of diamond drilling are preserved.

Recorded assessment data stored at the Assessment Files Research Office, Ontario Division of Mines, Toronto show that at least the following work has been performed in exploration for base metals. The Canadian Nickel Company Limited diamond drilled electromagnetic and magnetic conductors at 11 various locations for a total footage of 1301 m (4,267 feet). In 1971 the Freeport Canadian Exploration Company diamond drilled 800 m (2,625 feet) at eight scattered locations following a large-scale airborne electromagnetic survey.

Records of the Regional Geologist's Files, Kenora indicate that a ground magnetometer survey was undertaken in 1952 by Conwest Exploration Company Limited in the Furlonge Lake area in an effort to further delineate a number of visible pyrite (and pyrrhotite) showings which occur along the shore of the lake. No record of further work was found by the author.

During the 1976 field season, the Canadian Nickel Company Limited still held two claims 900 m (3,000 feet) north of Lou Lake. Other claims in good standing included several patented claims on and adjacent to the Konigson occurrence, the Straw Lake Beach Mine, the Straw Lake occurrence and the Viger occurrence, as well as a block of eight patented claims north and west of Mister Lake. Twelve new claims surrounding the Straw Lake Beach Mines patented property were staked by Projex Limited in the summer of 1976.

GENERAL GEOLOGY

All bedrock in the area is Early Precambrian (Archean) in age. Most of the Straw Lake area was described by Thomson (1934; 1935). Earlier reconnaissance work was performed by Lawson (1889) and Coleman (1894; 1896). Regional geological relationships from the Wabigoon area to the Lake of the Woods were synthesized by Goodwin (1965) and were compiled on the Kenora-Fort Frances Map 2115 (Davies and Pryslak 1967). Recent mapping at a detailed scale in adjacent areas to the west was performed by Edwards (1975) and Edwards and Lorsong (1976).

The map-area is divided into two halves by the east-trending, regional, Manitou Stretch-Pipestone Lake Fault. This fault is the eastern extension of the Pipestone-Cameron Lakes Fault (Edwards 1975) and the probable western continuation of the Manitou Straits Fault (Blackburn 1976a).

Most of the rocks north of the fault are complexly interlayered, steeply dipping and folded mafic, intermediate and felsic metavolcanics trending roughly east. Felsic pyroclastic rocks and flows predominate east of Straw Lake with intermediate pyroclastic rocks being more abundant south of Floyd Lake. Subvolcanic felsic porphyry "sills" are especially common in this zone. The Yoke Lake area and the northwest shore of Straw Lake are underlain by andesitic flows and pyroclastic rocks intercalated with lesser mafic and felsic metavolcanics. The composite Lawrence Lake Batholith consisting mainly of biotite-hornblende diorite and quartz diorite and a later hornblende-biotite trondhjemite, lying north of Missus and Floyd Lakes and east of Bluffpoint Lake, intrudes the volcanic rocks.

Stratigraphically, submarine mafic flows form the lowest identifiable sequence in steeply dipping folded rocks south of the Manitou Stretch-Pipestone Lake Fault. These are interlayered with intermediate and felsic pyroclastic rocks southwest of Sucan Lake and northeast of Line Bay, Pipestone Lake. At the latter location, pebble and cobble conglomerate and arkosic wacke are interbedded with the pyroclastics. In the vicinity of Thompson Bay, the mafic flows are capped by mafic pyroclastic and hyaloclastic rocks which are in turn overlain by arkosic wacke and turbidite arkosic wacke-siltstone at Thompson Bay. A similar sequence of metasediments occurs north and west of Esox Lake but here mafic pyroclastic and hyalocalstic rocks do not occur between metasediments and the underlying mafic flows. A fault slice of metasediments occurs along the Manitou Stretch-Pipestone Lake Fault, extending westward from Manitou Stretch. Apparently infolded metasediments also occur 1830 m (6,000 feet) west of Lou Lake.

Metagabbro, leucogabbro and altered peridotite intrude mafic flows between Line Bay, Pipestone Lake and Sucan Lake. A swarm of metamorphosed felsic porphyry and leucocratic trondhjemite dikes intrude mafic flows east of Sucan Lake. Metamorphosed, subvolcanic, felsic porphyry stocks intrude metavolcanic and metamorphosed mafic intrusive rocks 915 m (3,000 feet) southwest of Sucan Lake and in the vicinity of the south part of Esox Lake. Late granitic stocks occur within the belt between Esox and Seahorse Lakes and between Bending Lady and Furlonge Lakes. Syenodiorite of the Jackfish Lake (intrusive) Complex (Blackburn 1976b; Edwards and Lorsong 1976) (part of the Rainy Lake Batholith) borders the belt to the south.

STRUCTURAL GEOLOGY

The Manitou Stretch-Pipestone Lake Fault divides the area into two distinct structural regimes. The fault is a zone of variable width along which intense shearing and variable carbonatization has occurred.

North of the fault, structural trend is broadly arc-shaped, wrapping around the Lawrence Lake Batholith. Fold axes are traceable through Sullivan Lake (anticline) and the north part of Yoke Lake (syncline) but both axial traces merge into a strongly sheared pinch zone at Straw Lake where the belt is narrowest. This zone extends eastward through Mister and Missus Lakes and out of the map-area. South of Floyd Lake it merges into the Manitou Stretch-Pipestone Lake Fault.

Rocks south of the fault are more complexly folded. Evidence in the metasediments at Thompson Bay indicates refolding has taken place. Here, synclinally folded metasediments have been refolded about a northeast-trending, open antiform, resulting in a roughly tri-lobed structure. Three roughly east-trending, fold axes have been identified in metasediments and north and west of Esox Lake. Structure here has been modified by the intrusions of a granitic stock between Esox Lake and Seahorse Lake.

Tops from pillowed mafic flows between Lou Lake and Line Bay, Pipestone Lake indicate that the mafic flows have been folded in a complex manner concurring with evidence found in the metasediments.

Many of the tops found in mafic flows appear to have been rotated to some degree as a result of a strong east-trending regional foliation. Adjacent to the Jackfish Lake Complex, east-west deformation of the supracrustal rocks appears to overprint fold structures over a zone 600 m to 1500 m (2,000 feet to 5,000 feet) wide. The subvolcanic felsic porphyry located in this zone at the south end of Esox Lake, has been cataclastically deformed.

Late, left-lateral faults have offset the contact between the Jackfish Lake Complex and the "greenstone" belt.

ECONOMIC GEOLOGY

Mineral production in the area has been limited to one past gold producer, the Straw Lake Beach Mine (see "Mineral Exploration"). The fact that the four main gold occurrences in the vicinity of Straw Lake occur in different rock types suggests to the author that the gold mineralization is more structurally controlled (tectonic and possibly being related to the emplacement of the Lawrence Lake Batholith) than volcanogenic.

Some outcrops along the south shore of Straw Lake near the Straw Lake occurrence are cleaved in a NNE to northeast direction almost perpendicular to the east striking schistosity of adjacent outcrops. A similar cross cleavage was observed by the author in felsic pyroclastic rocks south and east of the Straw Lake Beach Mine.

Two northeast-trending lineaments visible on air photos and located in granitic rocks of the Lawrence Lake Batholith between Straw Lake and Floyd Lake, strike toward the mine area and may be related to the cross cleavage and possibly to gold mineralization.

The diamond drilling programs of Canadian Nickel Company Limited and Freeport Canadian Exploration Company were not successful in finding base metal deposits. The drilled conductors were either graphite and/or pyrrhotite and pyrite or peridotite.

Several outcrops of massive pyrite along the shoreline of Furlonge Lake were investigated in 1952 by Conwest Exploration Company Limited using a ground magnetometer. These massive sulphide mineral occurrences occur in an ENE-trending zone of mafic metavolcanics which show some magnetic contrast with the surrounding rocks and extend parallel to the contact of the Jackfish Lake Complex from west of Stonedam Lake almost as far east as Lou Lake and Esox Lake.

Massive pyrite and metamorphosed, cherty, magnetic iron formation are known to occur elsewhere in this zone, at Stonedam Channel (Edwards and Lorsong 1976) and south of Pipestone Lake (Thomson 1935). Several magnetic anomalies were crossed while traversing this zone.

Arsenopyrite and pyrite occur in a carbonatized and chloritized felsite dike on the east shore of a reversed-"L" shaped peninsula in Yoke Lake 600 m (2,000 feet) west of the creek into Crossroute Lake. The mineralization which occurs in two shallowly dipping ill-defined zones 1 cm to 5 cm thick consists of disseminated cubes and pyritohedra of pyrite in amounts up to 20 percent and disseminated blades and prisms of arsenopyrite in amounts up to 10 percent.

A north-trending zone of malachite and azurite-stained massive to disseminated pyrite and gossan is exposed over 2 m (6 feet) in a blasted pit on the north shore of a small bay almost due north of the extreme southeast corner of Sullivan Lake. Mineralization here appears to be associated with subhorizontal fractures filled with carbonate and quartz but pyrite was also observed to fill some amygdules in the black mafic flow host. A trench located 45 m (150 feet) north of this occurrence as well as the blasting at the site of the mineralization indicate that some work has been done at this location.

The trondhjemite and leucotrondhjemite subphases which form part of the hybrid outer phase of the Lawrence Lake Batholith are consistently mineralized with pyrite, usually as disseminated cubes but locally in more massive blebs. At one location on the west shore of Bluffpoint Lake, 2500 m (8,300 feet) north of the south tip of the lake a soft steel grey-blue mineral resembling graphite occurs with the pyrite.

It is recommended by the author that the area between Straw Lake and Manitou Stretch-Mister Lake-Missus Lake be re-examined for mineralization similar to that of the Straw Lake Beach Mine. Emphasis should be put on structural control of mineralization, perhaps related to batholith emplacement. The chalcopyrite occurrence on Sullivan Lake may also be a related type of mineralization.

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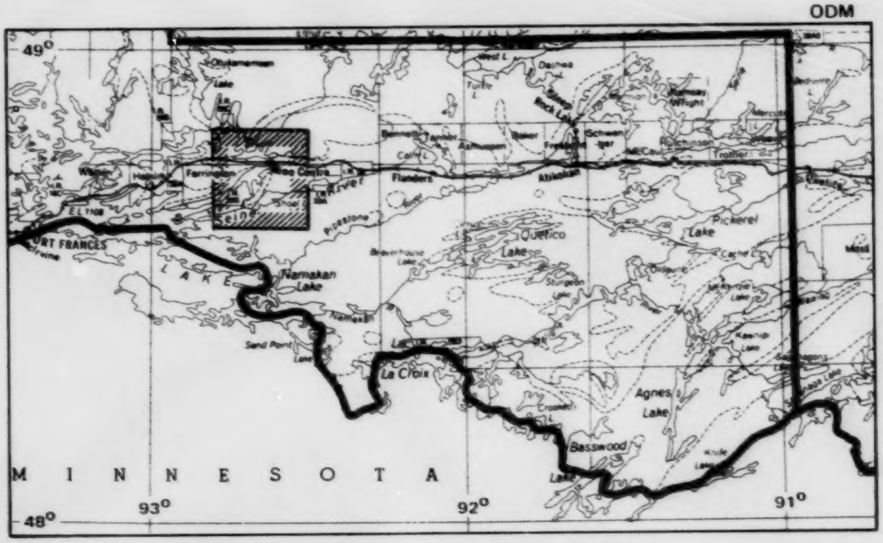
NO. 9 MINE CENTRE AREA

DISTRICT OF RAINY RIVER

John Wood[1]



LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

INTRODUCTION

The Mine Centre area bounded by Latitudes 48°37′30″N to 48°50′N and Longitudes 92°30′ W to 92°48′20″W (the eastern boundary of Farrington Township) encompasses approximately 525 km² (200 square miles) of the District of Rainy River. The community of Mine Centre which is located to the east and north of the central part of the map-area lies 61 km (38 miles) east of Fort Frances on Highway 11.

That part of the map-area covered during the 1975 field-season (about 250 km² or square miles) is bounded by the map-area limits to the north and west and approximately by the Seine River to the south and the Mine Centre-Shoal Lake road to the east. That part of the area mapped during 1975 is readily accessible by wheeled vehicle (four-wheel drive is recommended on some roads under wet conditions) and boat.

MINERAL EXPLORATION

The history of mineral exploration in the Mine Centre area dates back to the 1880s. In 1882 the Canadian Pacific Railway afforded access to Rainy Lake and the Lower Seine River area by way of Lake of the Woods. H.L. Bell (1968) gives an account of the area to which the reader is referred. Gold was found in quartz veins within the Mine Centre area in 1893. Between 1893 and 1904 many shafts were sunk but only three mines - the Olive, Golden Star, and Foley produced gold. By 1904 most of the gold mines were shut down and since then, except for a short revival of the main mines in the 1930s (see Tanton 1935) there has been little activity. R.C. Cone of Mine Centre still carries on a small scale gold mining operation.

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Although the search for gold continues, recent exploration has also included investigation for copper, lead, zinc, iron, and molybdenum (Regional Geologist's Files, Ontario Ministry of Natural Resources, Kenora). There are on record in the Regional Geologist's files some 36 mining companies and individuals who have performed exploration work in the area since 1940. Most of this work has been on a small scale in that the number of claims covered by any investigation has been small and there has been little in the way of a comprehensive geophysical-geological approach to the exploration. A notable exception is the 1975-1976 work of the Hanna Mining Company Limited who did geological and geophysical surveys, with follow-up diamond drilling, on 154 claims located to the east of Mine Centre and for the most part north of Highway 11. Exploration activity during the past field-season was restricted to the area immediately to the southeast of Barber Lake where exploration for gold was being carried out by R. Pitkanen from Fort Frances.

GENERAL GEOLOGY

The area, part of which was mapped by T.L. Tanton in 1934 (Tanton 1935; 1936), can be divided into three parts on a geological basis. Geographically, these three areas are a) north of the southern shore of Little Turtle Lake, b) between Little Turtle Lake and the Seine River, and c) south of the Seine River. Although the geographical subdivisions are not absolutely coincidental with the geological ones, they are very close. Area (a) is underlain by migmatites predominantly composed of a metavolcanic paleosome and trondhjemitic or granodioritic to quartz monzonitic neosome which are separated from rocks of area (b) by the Quetico Fault. Area (b) is underlain by metavolcanics, the "Keewatin" of Lawson (1913), metasediments, the "Seine Series" of Lawson (1913), and intrusive rocks of basic mafic, intermediate, and felsic composition. Area (c), the "Couchiching" of Lawson (1913), is composed of arenaceous metasediments and appears to be separated from area (b) by a fault.

The 1976 field mapping was mainly confined to areas (a) and (b). Mapping in area (c) suggests that the metasediments are a monotonous sandstone sequence of probable deep water origin. However, insufficient work was done to confirm this or to outline exactly the nature of the contact between the "Couchiching" and the "Keewatin" and "Seine", a problem of long-standing debate (see Lawson 1913).

Within the migmatite of area (a) a shadow volcanic stratigraphy can be observed in some localities and both large and small scale folds are present in the migmatite.

The geology of area (b) is dominated by intrusive rocks. The northwest corner of area (b) i.e. west of Barber and Gallo Lakes and north to the CN tracks (built along the Quetico Fault valley) is underlain by an intrusion with an outer zone of porphyritic quartz-biotite diorite and a core of porphyritic biotite-hornblende granodiorite. This intrusion has an igneous foliation parallel to the contact with the country rock; it shows no evidence of post-consolidation deformation and may be the youngest rock type in the map-area.

Centrally located on Bad Vermilion Lake is an anorthosite-gabbro intrusion; adjacent to it, to the northwest and southeast, are trondhjemitic sill-like bodies. Part of the large peninsula in the southern part of the lake is also underlain by trondhjemite. The trondhjemitic bodies appear to be younger than the anorthosite-gabbro although further detailed study may modify this conclusion. The anorthosite-gabbro shows a differentiation trend: from southeast to northwest the sequence is anorthosite, gabbroic anorthosite, anorthositic gabbro, gabbro, and diorite. The body is a polyphase intrusion and is locally heterogeneous in texture and composition. The upper gabbro-diorite phases contain magnetite and ilmenite.

The northwestern trondhjemitic intrusion is quartz rich, has a maximum thickness of about 1.6 km (1 mile) and extends from just west of the northeastern end of Bad Vermilion Lake, past Mudge and Bliss Lakes into Farrington Township to the west. Near its southeastern contact, quartz grains reach 6-7 mm in diameter; away from this contact the size and density of the quartz grains decrease and the feldspar becomes progressively more altered. Adjacent to the northwest contact of this intrusion and some 3 km (2 miles) east of Mudge Lake there is a spherulitic felsic metavolcanic unit which may be genetically related to the trondhjemite sill. The trondhjemite intrusion on the large central peninsula of Bad Vermilion Lake is also quartz rich, and texturally inhomogeneous. The southeastern trondhjemitic intrusion extends from just south of the east end of Bad Vermilion Lake southwest to Shoal Lake and westwards along the Seine River to the western boundary of the map-area. Although the rock is locally inhomogeneous, its overall composition changes from siliceous and leucocratic in the northeast to dioritic in the southwest. East of Chief Neverwash Creek, quartz is commonly porphyritic and feldspar is altered, having either a greenish colour, or a white sericitic appearance. The mafic component of all the trondhjemitic bodies is chlorite and all of them, the Shoal Lake one in particular, contain quartz veins which are host to gold mineralization, the basis for early mining activity in the area.

Within area (b) metavolcanics occur only between Little Turtle Lake and Bad Vermilion Lake with the exception of some inclusions of possible metavolcanics within the anorthosite-gabbro. Southwest of Barber Lake adjacent to Farrington Township the metavolcanics strike N45E and are sandwiched between the anorthosite-gabbro and trondhjemitic intrusions to the south and the granodiorite intrusion to the north. Southeast of Barber Lake the metavolcanics wrap around the granodiorite and their strike swings from N30E near Highway 11, to N45E north of Patton Lake, to N85E south of Little Turtle Lake. The metavolcanics are mainly felsic to intermediate in composition with minor mafic flows which generally are in the southeastern part of the metavolcanic sequence. The felsic to intermediate metavolcanics include flows, tuff, and lapilli tuff. The mafic metavolcanics are often amygdaloidal, pillows are notably absent and many of the flows are magnetic.

A small portion of the conglomerate southeast of the Shoal Lake trondhjemite was mapped in area (b). The conglomerate is clast supported with clasts of cobble to granule size. There is a diversity of clast types including granitic clasts. Tanton (1935) considered the conglomerate to be younger than the metavolcanics but older than the trondhjemitic intrusions.

There are mafic dikes and sills of a variety of ages, most are probably contemporaneous with volcanism although a minority may postdate the deformation which has affected all of the other rocks except the granodiorite.

STRUCTURAL GEOLOGY

As outlined under "General Geology", two faults, the Quetico Fault and the one underlying the Seine River and Grassy Lake, separate the area into small geological domains. In the migmatitic domain the rocks have been deformed under conditions of high pressure and temperature. The rocks are foliated to gneissic, and have been complexly folded. A gneiss dome is present in the northwestern part of the map-area, but further interpretation of structures in this domain has not yet been made.

Resolution of large scale structures within the metavolcanic domain is dependent on further mapping to the east and resolution of the genetic relationships between the various trondhjemitic intrusions. If the trondhjemitic intrusions are the folded remnants of one sill, a northeast trending anticlinal axis is present in the vicinity of Bad Vermilion Lake. The metavolcanics lack stratigraphic top indicators. Metamorphic grade in this domain is of greenschist facies rank.

ECONOMIC GEOLOGY

Of the three sub-areas outlined above, insufficient work was done in sub-area (c) to offer exploration suggestions. In sub-area (a) although minor disseminated pyrite was encountered in some of the granitic migmatitic rocks, no minerals of economic interest were observed. Quartz veins are common within sub-area (b). The presence of gold in some of these quartz veins is historic knowledge. Most quartz veins are less than 30 cm in diameter and of 43 veins sampled during fieldwork and assayed by the Mineral Research Branch, Ontario Division of Mines, 17 had gold-values greater than 0.01 ounces per ton. Of the 17, only one in the granitic body north of Bad Vermilion Lake and one in the similar body south of the lake had gold values greater than 0.50 ounces per ton.

Although not yet mapped in detail a reconnaissance study of the Shoal Lake trondhjemitic body just north of Shoal Lake indicated that galena, sphalerite, chalcopyrite, and molybdenite occur in northerly striking quartz veins. The veins are less than a metre wide and of indeterminate length, although some exceed 30 m (100 feet). Sulphide minerals may constitute up to 5 percent of the rock by visual estimation. It is possible that more of this type of mineralization is present within the body and a more detailed examination is warranted.

Two grab samples collected during fieldwork from a trenched outcrop of anorthosite at the southern end of Island Bay, indicated copper levels between 1 and 6 percent on spectrographic analysis by the Mineral Research Branch, Ontario Division of Mines. The extent of potential for further mineralization in this rock unit is not known. Magnetite and ilmenite occur disseminated, and in massive zones up to 3 m (10 feet) wide, in the gabbroic part of the anorthosite-gabbro complex.

Within the metavolcanic sequence, the best occurrence observed of sulphide mineralization is just north of Highway 11, 5.2 km (3¼ miles) west of Mine Centre at the Port Arthur occurrence (Regional Geologist's Files, Ontario Ministry of Natural Resources, Kenora) where chalcopyrite, sphalerite, and galena occur disseminated and in stringers and blebs in a sheared mafic, east striking amygdaloidal flow and in a fine grained felsic lens over a width of 15 m (50 feet). Several car loads of ore containing 3 to 3.5 percent copper, from a 10 by 20 m (35 by 60 feet) open pit, were shipped to Trail, B.C. in 1916. According to H.C. Bell (1968) this represented the highest grade material at this locality. Several hundred metres to the east there is a gossan on outcrops of foliated amygdaloidal intermediate flow rocks adjacent to the highway, suggesting that the mineralization may extend to the east. Some minor disseminated pyrite was found in the metavolcanics at a few other localities, but none of the samples of these taken by the field party contained more than 0.04 percent copper, nickel or lead as indicated by spectrographic analysis by the Mineral Research Branch. The metavolcanic sequence should not however be discounted as an exploration possibility, since there are felsic fragmental and flow rocks in the area, indicating paleogeographic proximity to a felsic volcanic centre to which the trondhjemitic intrusive rocks may be genetically related.

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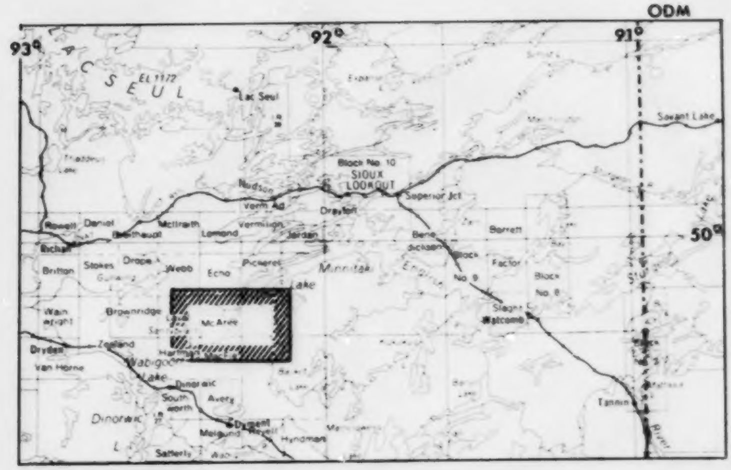
NO. 10 SANDYBEACH LAKE AREA

DISTRICT OF KENORA, PATRICIA PORTION

P.A. Palonen[1]


ODM
93°
92°
91°
50°
LAC SEUL
Lac Seul
Savant Lake
Block No. 10
SIOUX LOOKOUT
Hudson
Vermilion
Superior Jct
Drayton
Jordan
Rowell
Daniel
McIlraith
Lomond
Barrett
Bertrand
Richan
Britton
Stokes
Drope
Webb
Echo
Pickerel
Minnitaki Lake
Factor
Block No. 9
Block No. 8
Brownridge
McAree
Wainwright
Zealand
Hartman
Slaght
Watcomb
Dryden
Van Horne
Wabigoon Lake
Dinorwic
South
Avery
Tannin
Melgund
Revell
Hyndman
Sallerly

LOCATION MAP Scale: 1:1,584,000 or 1 inch to 25 miles

LOCATION

The Sandybeach Lake map-area is bounded by Latitudes 49°45′N and 49°54′N and by Longitudes 92°07′30″W and 92°30′W, an area of approximately 470 km^2 (180 square miles). The map-area includes McAree Township, parts of Webb, Echo, Pickerel, Laval, Hartman and MacFie Townships as well as unsurveyed land in the southeast corner. Gravel roads provide access to Sandybeach Lake and Pickerel Arm from Highway 72 to Sioux Lookout. A well maintained logging road leads from Highway 72 to the south end of Swimit and Keikewabik Lakes where cutting of timber is presently in progress. Field work, initiated in 1974, (Palonen and Speed 1974; 1975) was continued east in 1975 and 1976. Mapping of the mafic volcanic rocks along the west shore of Keikewabik Lake has been completed.

MINERAL EXPLORATION

At present several mining companies and individuals are active within the map-area. Goldlund Mines Limited conducted a surface diamond drilling program on its patented property in Echo Township. In McAree Township a geophysical anomaly was tested with one diamond drill hole by D. Wilkinson on a newly staked claim group. Two claim groups staked on the basis of geophysical evidence for Geophysical Engineering are located in the north end of McAree Township. Two claims have also been staked for Lynx-Canada Explorations Limited immediately to the north of Sandybeach Lake in McAree Township.

GENERAL GEOLOGY

Mapping during the past summer was confined to rocks of the southern limb of the Minnitaki Lake metavolcanic belt. Four varieties of mafic metavolcanics are present:

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[1] Resident Geologist, Ontario Ministry of Natural Resources, Sioux Lookout.

fine-grained massive flows, porphyritic massive flows, pillowed porphyritic and fine-grained flows, and thin pyroclastic beds. Individual flows are on the order of 10 m (30 feet) thick and of limited lateral extent. Excellent exposure in several areas indicates that many flows consist of pillows 1 m (3 feet) in diameter at the base giving way upward to massive lava in the middle of the flow. The upper 3 m (10 feet) also consist of pillows with the upper surface showing pillow breccia and infolded fragments of selvedge. Preliminary data indicate that the volcanic flows dip steeply and face to the northwest. Size of the white plagioclase phenocrysts appears to be independent of position in the flow. Largest phenocrysts are 20 cm in diameter although crystals of 2 cm diameter are most common.

The Basket Lake Batholith is intruded into the southern metavolcanic belt and forms the southeast contact. Thin dikes and sills of intrusive rock are found within the volcanic sequence. Flows at the basal part of the volcanic pile are terminated against the batholith. Rocks of the Basket Lake Batholith range in composition from granodiorite to quartz monzonite (Szewczyk and West 1976). Medium grain-size and uniform pink colour are characteristic of the homogeneity of the mass. Alignment of biotite flakes parallel to the contact give the felsic rock a slightly gneissic appearance. The Swimit Lake Stock appears similar in composition and may be part of the Basket Lake intrusion. A similar small stock occurs at the north end of June Lake.

ECONOMIC GEOLOGY

During mapping between Keikewabik and Minnitaki Lakes several old trenches were discovered. These are located in small quartz veins which generally offer little possibility of mineable volumes. Several flakes of molybdenite were noted in quartz breccia in the granitic intrusion at June Lake. Assays of three samples from this locality by the Mineral Research Branch failed to show any molybdenum and only traces of gold. As stated previously, little exploration for base metals has been recorded in the Sandybeach Lake area. The thick pyroclastic units exposed on Sandybeach Lake and reported in 1975 (Palonen and Speed 1975) warrant examination in this regard.

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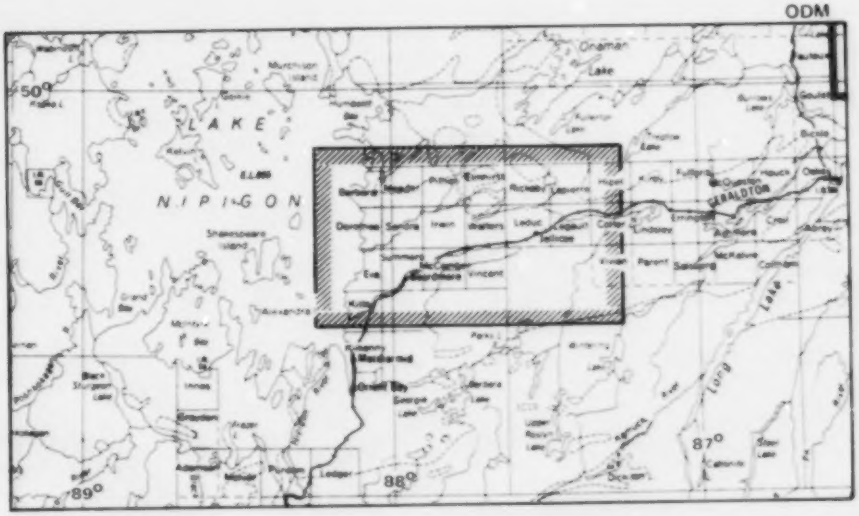
NO. 11 STRATIGRAPHY AND STRUCTURE OF THE STURGEON RIVER AREA

DISTRICT OF THUNDER BAY

W.O. Mackasey[1]



LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

LOCATION

The area is situated on the east shore of Lake Nipigon and is bounded by Latitudes 49°30′ and 49°52′30″N and Longitudes 87°15′ and 88°15′W. The towns of Beardmore and Jellicoe are located within the map-area. The City of Thunder Bay lies to the southwest, a distance of approximately 185 km (115 miles) by road. Highway 11 (the Trans-Canada Northern Route) passes through the map-area. A series of secondary roads provides access to much of the area.

MINERAL EXPLORATION

The area was originally prospected for iron deposits at the turn of the century. Gold was first discovered in the area in 1916 and the establishment of the Leitch, Sand River, Northern Empire and Sturgeon River mines within the area saw gold production from 1934 to 1965. Gold, base metals and iron have been actively explored for over the last ten years. Details on exploration within the map-area have been described by Mackasey (1970a,b,c; 1971; 1974; 1975a,b); Mackasey and Wallace (1974); and Mackasey *et al.* (1976a,b).

GENERAL GEOLOGY

The map-area is underlain dominantly by east-striking Early Precambrian metasediments and metavolcanics (Mackasey 1972) that occur along the boundary of the Wabigoon and Quetico Belts (Mackasey *et al.* 1974). A month was spent examining a 15 km (10 miles) wide cross section of metasediments within the Quetico Belt. These metasediments consist of a series of thinly bedded sandstone, siltstone and minor argillite. The most prominent sedimentary feature observed was graded bedding, and channeling and cross-bedding were found in several locations throughout the sequence.

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[1] Central Archean Subsection Leader, Precambrian Geology Section, Geological Branch, Ontario Division of Mines, Parliament Buildings, Toronto.

A progressive increase in metamorphic grade was observed in the metasediments from greenschist facies rank at the northern contact with metavolcanics, to amphibolite facies rank near the contact with granitic rocks to the south. The metasediments of amphibolite facies rank still retain primary bedding features. Garnet, staurolite, andalusite and cordierite were visible in hand specimen.

Field work is scheduled to be continued during 1977.

STRUCTURAL GEOLOGY

The metasediments have been folded into a series of tight, east-striking folds that parallel the structural trend of the metavolcanics and metasediments in the adjacent Wabigoon Belt to the north. The presence of folding is at variance with the north facing homoclinal assemblage shown by Peach (1951) for less well exposed rocks to the west of the present area of mapping.

Greenschist facies metasediments commonly exhibit a cleavage parallel to bedding, whereas the amphibolite facies rocks generally possess a mineral foliation having only a weak cleavage.

ECONOMIC GEOLOGY

The most important gold deposits are confined to the boundary between the Quetico and Wabigoon Belts (Mackasey *et al.* 1974). Copper is found in east-striking shear zones and as disseminated deposits within metavolcanic rocks; as disseminated deposits (with molybdenum) in granitic intrusives (Mackasey 1975a); and in north-trending, late faults that transect all rock types (Mackasey 1975b). Iron deposits consist of magnetite and hematite iron formation (Algoma type, Gross 1965) and are confined to the Wabigoon Belt.

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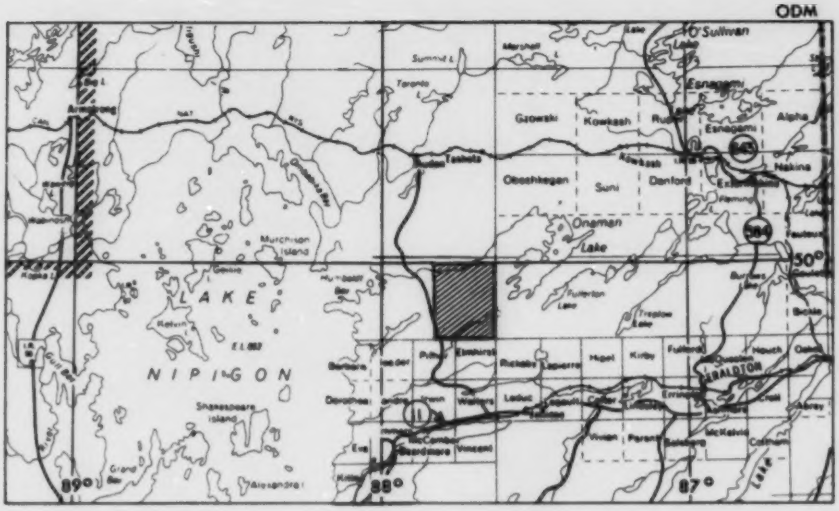
NO. 12 CONGLOMERATE LAKE AREA

DISTRICT OF THUNDER BAY

S.E. Amukun[1]



LOCATION MAP

Scale: 1:1.584,000 or 1 inch to 25 miles

LOCATION

The central portion of Conglomerate Lake area is located about 30 km (18 miles) northwest of the village of Jellicoe on the east side of Lake Nipigon. The city of Thunder Bay lies about 225 km (140 miles) west of Jellicoe via Highway 11 (the Trans-Canada Northern route). A number of secondary roads including Highway 801 (and its northerly extension to Auden), Con Lake Road, Castlewood Lake Road and Tashota Mine Road provide excellent access into all parts of the map-area.

The map-area is approximately 260 km^2 (100 square miles), being bounded on the east and west by the eastern boundary of Nipigon Provincial Forest Reserve, and Longitude 87°50'W, respectively, and on the south and north by the northern boundaries of Elmhirst and Pifher Townships and Latitude 50°00'N respectively.

MINERAL EXPLORATION

Conglomerate Lake area is situated between two mining areas that have repeatedly been prospected. The area to the north was initially investigated for gold occurrences following the discovery of iron deposits in 1904 and the completion of the C.N.R. line through the area in 1913 (Moore 1909; Hopkins 1917; 1916) and was investigated as the following map-areas: Kowkash Gold Area (Hopkins 1916; 1917), Tashota-Onaman Gold Area (Gledhill 1925), Kowkash-Ogoki Gold Area (Kindle 1931), Tashota Area (Amukun 1975) and North Onaman Area (Thurston 1976). The "Sturgeon River Gold Belt" to the south (Mackasey and Wallace 1974; Mackasey *et al.* 1974; Pye *et al.* 1966; Bruce 1936; Laird 1937), has likewise been the focus of extensive exploration activity, which started in the 1920s after gold was discovered in the Beardmore area in 1927 (Mackasey and Wallace 1974). Changing economic conditions and exploration technology have often encouraged renewed interest in gold and therefore a re-examination of the old prospects; however in the 1950s a shift in exploration emphasis was directed towards base-metals. Several gold and base metal prospects in the surrounding areas were discovered and developed (some to production), among them were: the Tash-Orn, Jacobus, and Rickaby prospects; and the Adair, Wascana, Edgelake, Tashota Goldfields, Orphan, and Sturgeon River mines.

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[1] Geologist, Precambrian Geology Section, Geological Branch, Ontario Division of Mines, Parliament Buildings, Toronto.

Following the discovery of gold and base metal prospects in the surrounding country prospecting and staking activity spilled over into the current map-area. Several gold and base metal prospects were discovered in the Conglomerate Lake area, and some of these have been re-examined sporadically since the early 1900s.

A syndicate composed of Lynx-Canada Explorations Limited, Dejour Mines Limited, and Canadian Reynolds Metals Company Limited acquired a property in the northeast portion of the map-area in July, 1975 by a grubstake arrangement, to tie onto a group of 23 leased claims optioned from Headway Red Lake Gold Mines Limited and Carndesson Mines Limited (Thurston 1976). Although exploration in this area, by the various property owners, has centred on the ground now covered by the leased claims to the north, some of the exploration work covered the extreme northeast portion of the map-area. The history of the property began in 1922 when claims were staked to cover a 1916 gold discovery by Brennan and partners. Although some of the outcrops on the property contained galena, sphalerite and silver mineralization, the property was allowed to lapse due to low gold values (Thurston 1976). The ground was re-staked and optioned at various times by numerous individual(s) before it was acquired by Coulee Lead and Zinc Mines Limited and Headway Red Lake Gold Mines Limited (formerly Headvue Mines Limited) who optioned the prospect to Noranda Exploration Company Limited in 1971 and to the syndicate led by Lynx-Canada Explorations Limited in 1975 (Thurston 1976). The syndicate is continuing geological, geophysical, and diamond drill surveys. Most of the detailed and extensive exploration surveys previously conducted on the optioned grounds, including geology, geophysics and diamond drilling (5810 m or 19,061.5 feet in over 50 holes for the "Coulee" ground, and 12 935 m or 43,438 feet in 192 holes for the "Headway" ground) was reported by Thurston (1976). Thurston also quoted an estimated total tonnage of 250,000 tons of Ag-Zn mineralization at a weighted average grade of 1.3202 ounces Ag per ton and 4.44 percent Zn (or $10.96 per ton, 1952 prices) for the Headway Red Lake Gold Mines property and traceable zones of Pb-Zn-Ag mineralization for the Coulee Lead and Zinc Mines property. Other surveys conducted in the northeast portion of the map-area, to the south of the optioned grounds were done by: The American Metal Company of Canada, who conducted geological and geophysical work on this area in 1947/8. This company dropped the ground. In 1967 a portion of this area was tested by geophysical (magnetic and electromagnetic) surveys of Palomino Explorations Limited which culminated in 150 m (500 feet) of diamond drilling. No evidence of economic metallic mineralization was reported but a massive pyrite-pyrrhotite zone was intersected in core widths of up to 8 m (25 feet) (Assessment Files Research Office, Ontario Division of Mines, Toronto). No further work is reported until Noranda Exploration Company Limited optioned the "Headway" and "Coulee" properties in 1971. The company personnel staked a large block of claims between, and to the south of the properties. Following geochemical, geological, magnetic and electromagnetic surveys, the massive pyrite-pyrrhotite zone was outlined and tested at depth by two holes totalling over 180 m (600 feet). A wider intersection of over 20 m (70 feet) was cut by both of the holes (Thurston 1976).

A Pb-Zn-Cu-Ag prospect located 2.5 km (1.5 miles) northwest of Con Lake and east of Con Creek is locally known as the "Con Creek showing". The showing was first reported as the "Wells and Johnson find" by Gledhill (1925, p.81) and was initially staked and prospected for gold. The ground was apparently acquired by New Bidlamaque Mines Limited in 1959, who hired Sulmac Exploration Services Limited to conduct electromagnetic and magnetic surveys. A consequent programme of six diamond drill holes totalling 633.7 m (2,079 feet), outlined a narrow zone of Zn-Cu-Pb-Ag mineralization. The claims lapsed and in 1971/72, the ground was restaked by two Beardmore prospectors, who optioned it to Shawmin Explorations Limited. In 1973 Shawmin

Explorations Limited conducted an electromagnetic survey and diamond drilling covering the showing. Sphalerite, galena and chalcopyrite were observed on surface and in trenches, and four diamond drill holes totalling 158 m or 520 feet intersected narrow widths of pyritiferous zones containing minor zinc and copper.

The Kenty showing (now owned by William Z. Langridge) is located about 1.5 km (1 mile) south of the east end of Conglomerate Lake. It was first reported by Gledhill (1925) and subsequently by Moorhouse (1938) as a gold molybdenite showing that was discovered in 1924 by the Kenty brothers. After mechanical work was conducted, the property was abandoned following World War II and the ground remained quiescent until the early 1950s when it was transferred to William Langridge Jr. Some mechanical surface work was conducted by Langridge before he optioned it to Norsco Mines Limited (Chontor Mines option) in 1955, and to Jorsco Exploration Limited in 1960 and 1962. Geophysical surveys and diamond drilling were completed as follows: three holes totalling 419 m (1,375 feet) in 1955, eight holes totalling 739 m (2,425 feet) in 1960, and four holes totalling 656 m (2,153 feet) in 1962; but the surveys failed to outline any sizeable deposit of economic minerals. Only minor native gold, molybdenite and pyrite are reported (Moorhouse 1938, p.20; Assessment Files Research Office, Ontario Div. Mines, Toronto). No work was recorded after 1962. The prospect is now completely covered by overburden and could not be located on the surface.

Other exploration in search of base metal and industrial minerals including diamond drilling, geophysical surveys (airborne and ground), and geological surveys, has been conducted in the area and filed in Assessment Files by: 1) Bonnie Gold Mines Limited, South Onaman River area (1952), 2) Amax Exploration Incorporated, Castlewood Lake area (1972), 3) The Coniagas Mines Limited, South Onaman River area (1952), 4) Hudson Bay Exploration and Development Company Limited, Grasser Lake area (1972), and Jacobus Mining Corporation Limited, Pinel Creek area (1972).

GENERAL GEOLOGY

Previous geological studies of Gledhill (1925) and Kindle (1931) covering the northern portion of the map-area were mostly of reconnaissance nature. All of the map-area was included in the detailed mapping of the South Onaman area (Moorhouse 1938) and some of the rock units outlined by the detailed mapping of the North Onaman area (western half) immediately to the north (Thurston 1976; Thurston *et al.* 1976) extend into the map-area.

Except for swarms of Middle to Late Precambrian (Proterozoic) diabase dikes, the bedrock is entirely of Early Precambrian (Archean) age, and is composed of metavolcanics (50 percent of map-area), metasediments (15 percent) and granitic rocks (35 percent). The Early Precambrian rocks of the Conglomerate Lake area lie between the ENE-trending Tashota-Onaman metavolcanic belt (Thurston 1976; Amukun 1975) to the north, and the east-trending Geraldton-Beardmore metavolcanic-metasedimentary belt (Mackasey 1970; 1972; Mackasey *et al.* 1974; Pye *et al.* 1966) to the south. These belts are grouped together in the Wabigoon Belt, (Goodwin 1970; Mackasey *et al.* 1974) a major subdivision of the Superior Province of the Canadian Shield (Goodwin 1970). The Conglomerate Lake metavolcanics are predominantly of mafic to intermediate composition with only very minor felsic metavolcanics. The metavolcanics mainly comprise massive, pillowed and amygdaloidal porphyritic flows, flow- and pillow-breccias and minor pyroclastics, which have been highly altered by carbonatization, cataclasis and metamorphism. Carbonatization is extensive, appears to be the principal type of alteration, and produces white weathering especially in the usually medium-grained, mafic to intermediate metavolcanics. The minor felsic metavolcanics, also severely altered, occur exclusively as narrow pyroclastic (tuff) bands intercalated with the mafic to intermediate metavolcanics. The extensive, and thick successions of intermediate to felsic coarse pyroclastic rocks reported by Mackasey and Wallace (1974) for the southern belt, and by Thurston (1976) and Amukun (1975) for the northern belt are rare in the Conglomerate Lake area. A well-defined, but narrow metasedimentary belt lies within the metavolcanics, astride the Onaman River system and Con Creek. The clastic metasedimentary unit appears to be locally derived. A typical unit is made up of a clast-supported, polymictic, pebble to cobble conglomerate, with a variable matrix (chloritic, sandstone or volcanic matrix), intercalated with thin beds of feldspathic wacke, arkosic arenite, mudstone and tuff. At a point just south of Macdonald Lake the trend of the metasedimentary unit swings abruptly from the

Onaman River system which trends northeasterly to Con Creek which trends northwesterly. The cause of the near right-angle turn is tentatively attributed to a complex system of faulting.

Roughly circular, mafic to intermediate intrusions of gabbro and diorite, with local quartz-rich varieties, constitute about 30 percent of the map-area. Field examination suggests that these intrusions represent the upper contact phase of underlying masses of batholithic "granite", as yet unexposed by erosion. Features observed include: 1) numerous amphibolite (metavolcanic) xenoliths; 2) several later but related pink granitic dikelets and smaller sills intrusive into the major intrusions and hence containing coarser-grained gabbro/diorite xenoliths; 3) a few dikelets of pegmatite and aplite (possibly the latest potash-rich phase) that intrude all the rocks of the major bodies, a feature similar to that of the surrounding granitic stocks (Mackasey and Wallace 1974, p.54; Amukun 1975; Thurston 1976, p.38); 4) minor mappable units of massive, medium-grained metagabbro that are thought to be remnants of roof pendants occur in the intrusive body.

There are two bodies of granitic rocks within the map-area. The stock bordering the northeast edge of the area is part of a larger batholith that lies west of Onaman Lake (Thurston 1976, p.36), and consists of medium- to coarse-grained, granodiorite to quartz monzonite. A smaller but similar boss of quartz monzonite outcrops west of Con Creek. The granitic rocks constitute about 5 percent of the map-area.

Late diabase dikes postdated granitic intrusions and cross-cut all other rocks in the area. Some of these dikes form conspicuous ridges and the major dike is porphyritic ("greenspar").

The Precambrian bedrock is covered by extensive glacial and fluvioglacial Pleistocene deposits.

STRUCTURAL GEOLOGY

The regional structural trend is ENE but within the map-area major lithologic units trend NNE and NNW. A complex system of faults is suspected to account for the abrupt near right-angle swing of the metasedimentary trend. Only a few isolated minor folds of z and s types are exposed in the map-area and other field criteria for recognition of fold patterns is not readily apparent and where observed provide inconclusive data.

ECONOMIC GEOLOGY

There are no current or past producers in the map-area. Nearly all of the early (1900s) exploration activity in the area was directed towards the search for gold following successful gold discoveries in the Tashota-Onaman gold belt (to the north), and Sturgeon River gold belt (to the south). In the 1950s, a small tonnage deposit was outlined by Headway Red Lake Gold Mines Limited and a mineralized zone was outlined by Coulee Lead and Zinc Mines Limited, in the area now under option to the syndicate formed by Lynx-Canada Explorations Limited, Dejour Mines Limited and Canadian Reynolds Metals Company Limited (Thurston 1976; Assessment Files Research Office, Ontario Div. Mines, Toronto). Subsequent surveys by Lynx-Canada-Dejour-Canadian Reynolds have outlined additonal Ag-Zn-Cu (±Pb,Au) mineralization, which those companies are currently investigating.

During the field season grab samples were taken from several trenches located in the Con Creek showng, now exposed along the Con Lake road system. The showing consists of a narrow zone cut by thin quartz veins containing sphalerite, galena, chalcopyrite, and silver mineralization over very narrow widths (2-15 cm or 1-6 inches). Assays of the best mineralized material returned the following ranges of metal values: copper 0.21 to 1.02 percent, lead 0.80 to 9.38 percent, zinc 0.66 to 19.2 percent, silver 1.78 to 15.14 ounces per ton, and gold 0.01 to 0.08 ounces per ton (assays by Mineral Research Branch, Ontario Div. Mines). The association (and possible relationship) between this mineralization and highly sheared, sericitized and sometimes carbonatized, north-trending quartz-feldspar porphyry dikes is readily apparent in the northeast portion of the map-area, and may provide a prospecting guide for future exploration surveys of this area.

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NO. 13 CARBONATITE-ALKALIC COMPLEXES

R.P. Sage[1]

INTRODUCTION

As part of a continuing program to evaluate the economic potential of alkalic rock and carbonatite complexes in Ontario, 11 of these complexes, at Poohbah Lake, Sturgeon Narrows, Squaw Lake, Wapikopa Lake, Schryburt Lake, Shenango Township, Nemegosenda Lake, Lackner Lake, Seabrook Lake, Carb Lake and Cargill Township, were examined during the past field season.

Examination of records within the Assessment Files Research Office of the Ontario Division of Mines indicated the possibility that alkalic complexes of Early Precambrian age have a economic potential much lower than those of a much younger age. As a result of this observation four alkalic complexes of Early Precambrian age were selected for sampling and data gathering as a basis for comparison of the older and younger alkalic intrusions. Early Precambrian carbonatites are not known to exist in Ontario.

The Early Precambrian alkalic complexes selected for examination were Poohbah Lake, (type locality for the alkalic rock malignite); Sturgeon Narrows and Squaw Lake (a joint project between the author and N.F. Trowell) and Wapikopa Lake. These Early Precambrian alkalic rock intrusions lie within three different subprovinces of the Superior Province.

The Carb Lake and Cargill Township carbonatite complexes are Middle Precambrian in age and are located respectively in the Kenyon and Kapuskasing Subprovinces. All other remaining complexes are Late Precambrian in age and with the exception of the Schryburt Lake and Seabrook Lake complexes are located in the Kapuskasing Subprovince. The Schryburt Lake carbonatite complex is located in the Gods Lake Subprovince and the Seabrook carbonatite complex lies within the Abitibi Subprovince.

A reconnaissance traverse was completed over the Port Coldwell complex to gather data on that intrusion to be used in conjunction with other data obtained at Killala Lake and Prairie Lake in defining the Late Precambrian alkalic rocks north and northeast of Lake Superior (*see* Sage 1975). The results of this traverse are not discussed in the following descriptions.

"CARB" LAKE CARBONATITE COMPLEX

DISTRICT OF KENORA, PATRICIA PORTION

LOCATION AND ACCESS

The Carb Lake carbonatite (location Map A) is one of the most northerly located carbonatite complexes in Ontario. The intrusion is located at approximately 54°46'N Latitude and 92°01'W Longitude, 10 km (6 miles) from the Ontario-Manitoba border. The complex lies 384 km (240 miles) WNW of Pickle Lake or 422 km (264 miles) NNE of Red Lake. The complex is accessible only by float-equipped aircraft to either Camp Lake (local name) on the northern edge of complex or to Carb Lake (local name) in the centre.

The topography is low and undulating and mostly swampy. Outcrop is not known to exist on the complex.

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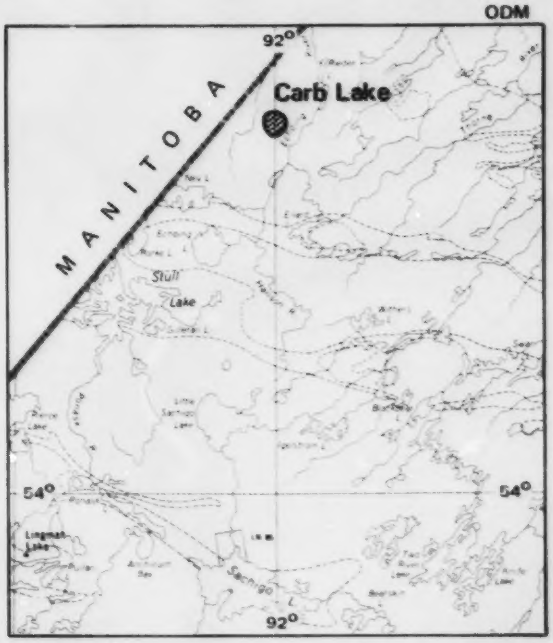
[1] Geologist, Precambrian Geology Section, Geological Branch, Ontario Division of Mines, Parliament Buildings, Toronto.

The intrusion has a surface area of approximately 8.0 km^2 (3.1 square miles), estimated on the basis of aeromagnetic expression. The intrusion has a strong circular aeromagnetic expression which is well illustrated on ODM-GSC aeromagnetic maps 3684G, 3692G, 3685G, and 3693G.



LOCATION MAP A

Scale: 1:1,584,000
or 1 inch to 25 miles

MINERAL EXPLORATION

In 1968, Big Nama Creek Mines Limited and Larandona Mines Limited staked the Carb Lake carbonatite complex, completed a magnetometer survey, and drilled four diamond drill holes totalling 555 m (1,849 feet)[1]. The company also completed airborne magnetic and radiometric surveys (D.A. Seeber, Northgate Exploration Limited, personal communication 1971).

Bennett and Riley (1969) examined core and found in addition to the usual carbonatite mineral assemblage, the rare earth carbonates synchysite and ancylite.

GENERAL GEOLOGY

The Carb Lake carbonatite complex lies within the Kenyon Subprovince of the Superior Province. This subprovince is characterized geophysically by a strong linear, WNW-trending aeromagnetic pattern (ODM-GSC 1970). Mapping by Bennett and Riley (1967) and Riley and Davies (1967) indicated that Early Precambrian felsic intrusive rocks outcrop east of the Carb Lake carbonatite.

The core from holes 3 and 4 of Big Nama Creek Mines Limited and Larandona Mines Limited examined by the author, is composed dominantly of pink to grey white sovite with minor amounts of biotite, magnetite, and phlogopite. The core contains minor zones (up to 1-2 m) of silico-carbonatite (greater than 30 percent silicate and oxide minerals) and biotitite (greater than 70 percent biotite with minor magnetite). Thin zones, less than 0.3 m (1 foot) wide, of nearly pure magnetite are locally present. The carbonatite is well banded at 30-45 degrees to the core axis, and all rock types: sovite, silicocarbonatite, biotitite, and magnetite, are so intimately mixed that pure samples of any one type greater than 15 cm long are difficult to obtain. The silicocarbonatite and biotitite often contain numerous, nearly pure, carbonate segregations or veins which look like breccia. Several thin (less than 2 mm wide) seams of fibrous blue-green amphibole were noted.

The core is unusual in that it is very vuggy. The vugs are roughly elongated parallel to the banding, in places exceed 1 cm in diameter, and are lined with pyrite, fluorite, and euhedral carbonate crystals. Some of the vugs appear to follow fractures and may be near-surface, solution-deposition phenomena rather than miarolitic cavities.

K. Bell and D. Watkinson of Carleton University (1972, unpublished data) reported K-Ar isotopic ages of 1822±96 m.y. and 1826±97 m.y. on biotite samples taken from diamond drill core.

STRUCTURAL GEOLOGY

The lack of outcrop makes structural interpretation difficult. A regional aeromagnetic map (ODM-GSC 1970a) of the area suggests that the intrusion may be located along a northwest-trending lineament.

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[1] Information from Assessment Files Research Office, Ontario Division of Mines, Toronto.

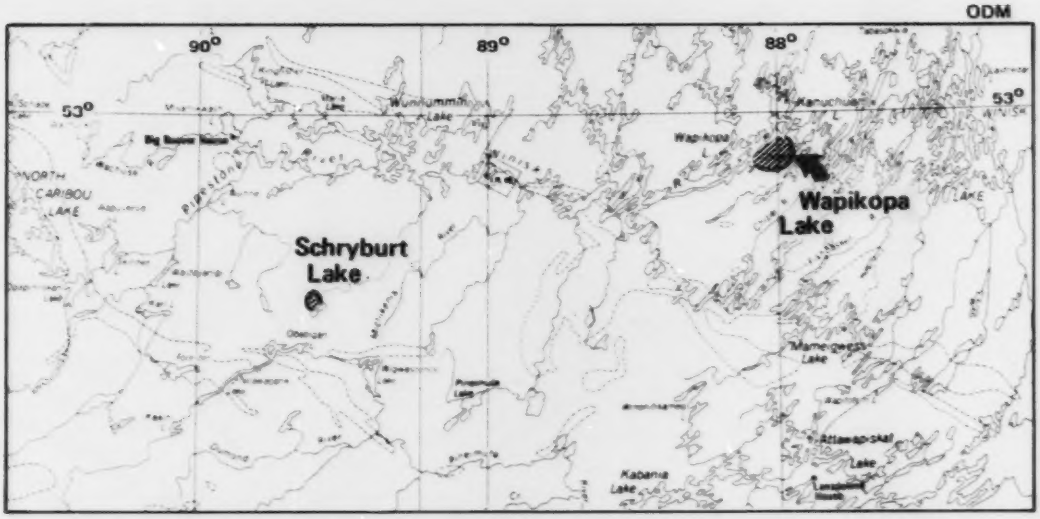
Mineralogic banding in the core drilled at a 50 degree plunge, varys from 30 to 50 degrees to the core axis, and indicates that the banding in the intrusion is vertical or nearly vertical.

RECOMMENDATIONS FOR THE PROSPECTOR

The complex warrants examination for its vermiculite, apatite, and rare earth potential.

SCHRYBURT LAKE CARBONATITE COMPLEX

DISTRICT OF KENORA, PATRICIA PORTION


ODM
90°
89°
88°
53°
53°
Schryburt Lake
Wapikopa Lake
NORTH CARIBOU LAKE
Big Beaver House
Pipestone
Wunnummin Lake
Winisk
Wapikopa L.
Karuchuwi L.
Mameigwess Lake
Attawapiskat
Lake
Lansdowne House
Kabania Lake

LOCATION MAP B

Scale: 1:1,584,000 or 1 inch to 25 miles

LOCATION AND ACCESS

The Schryburt Lake carbonatite complex is located at approximately 52°37'N Latitude and 89°37'W Longitude, and immediately west of Schryburt Lake. Schryburt Lake is located approximately 128 km (80 miles) northeast of Pickle Lake and is easily accessible by float-equipped aircraft. The complex has a prominent circular aeromagnetic expression (ODM-GSC aeromagnetic map 938G) which combined with very limited outcrop, suggests that the complex has a surface area of approximately 4.4 km^2 (2.4 square miles).

Outcrop on the carbonatite complex is nonexistent and mapping of the complex is limited to areas of regolith soil where pitting can recover samples of the underlying rock. At the rapids on the creek flowing north from Schryburt Lake, frost heaved slabs of fresh carbonatite are present which can be sampled with little difficulty. The surface of the complex is low and rolling and consists of elongated rounded ridges of gravel and boulders separated by low marshy ground.

Two outcrops of banded granitic gneiss were located on the south side of Schryburt Lake and presumably the complex was emplaced into rocks of this type.

MINERAL EXPLORATION

There is no record of any work on the complex filed with the Assessment Files Research Office, Ontario Division of Mines.

Data supplied to the Ministry, courtesy of E.I. DuPont De Nemours and Company Limited indicate that in 1961 the wholly owned Many Lakes Exploration Company Limited completed 28 pits and trenches on the complex in the search for niobium mineralization. This work disclosed niobium values but the values were highly variable and erratic and work was discontinued. Work by this field party indicated that one of the former pits of company was anomalously high in radioactivity, the source of which is unknown. Samples collected from this pit by the author are being examined, to identify the mineral and element causing the radioactivity. The complex is presently under the control of the International Minerals and Chemical Corporation (Canada) Limited.

GENERAL GEOLOGY

Samples collected from the pits and trenches indicate the complex is composed of predominantly calcitic carbonatite. Bands of nearly pure sovite alternate with bands of silico-carbonate (greater than 30 percent oxides and silicate minerals). One pit exposed a coarse-grained dolomite dike. In the carbonate, very pronounced bands of nearly pure actinolite, apatite, magnetite, biotite, or pyrrhotite alternate with pink to pinkish white carbonate. The rocks are highly variable in colour, texture, and grain size, but generally could be classified as equigranular and medium grained.

One outcrop of granitic rock in the northeast corner of the complex is strongly fenitized and extensively cut by carbonate dikes.

A brief description of this complex was previously given by the author (Thurston *et al.* 1975).

STRUCTURAL GEOLOGY

The Schryburt Lake complex lies within the Gods Lake Subprovince of the Superior Province. The lack of outcrop in the surrounding terrain and over the complex prevents any interpretation of possible structural relations within the complex or between the complex and its enclosing rocks. Relict banding in the residual soils exposed in the trenches are highly variable in their orientations.

Regional aeromagnetic maps (ODM-GSC 1970a) suggest that the complex may be located along a northwest-trending linear feature.

RECOMMENDATIONS FOR THE PROSPECTOR

Approximately 3 percent of the complex has been examined, disclosing erratic values in niobium and in one of the old test pits anomalously high radioactivity. The complex requires much additional testing for its niobium potential and may warrant close examination for uranium mineralization. The complex needs to be tested for its apatite, which may occur as residual soil infillings on the bedrock surface of the complex. Vermiculite concentrations may occur either alone, or in conjunction with apatite or other mineral commodity. The apatite should be checked for rare earth content.

WAPIKOPA LAKE ALKALIC COMPLEX

DISTRICT OF KENORA, PATRICIA PORTION

LOCATION AND ACCESS

The Wapikopa Lake alkalic rock complex (location map B) lies at approximately 52°45′54″ N Latitude and 88°00′W Longitude. Access to the complex is by float-equipped aircraft to Wapikopa Lake which is an expansion of the Winisk River. Wapikopa Lake lies approximately

218 km (136 miles) northeast of Pickle Lake. The alkalic complex is bordered on its northwest and east sides by Wapikopa Lake.

Scattered outcrops occur within the interior of the complex along the west, north and east sides, but the best exposures are along Wapikopa Lake on the northwest corner of the complex. Outcrop is rare in the southern portion of the complex.

The complex has a surface area of approximately 98.5 km^2 (38.5 square miles) and its oval shape, elongated on an east-west axis, is well illustrated on ODM-GSC aeromagnetic maps 969G and 979G.

MINERAL EXPLORATION

No assessment work has been filed for the area underlain by the Wapikopa Lake complex, but evidence of former claim staking was noted by this field party.

GENERAL GEOLOGY

The alkalic rocks of the complex can be broken into two fundamental rock types: (1) a mafic, amphibole-rich phase peripheral to the intrusion; and (2) coarse-grained syenite.

The mafic-rich phase is massive, medium grained, black to greenish black and with increasing feldspar content grades to a mafic syenite. The more mafic phases commonly contain apatite in quantities approaching an estimated 15 percent by volume; isolated sphene crystals are not uncommon. The best exposures of this rock type occur in the southwest corner of the complex and along the shoreline of Wapikopa Lake. Outcrops of this unit are sparse and geologic mapping combined with aeromagnetic data (ODM-GSC aeromagnetic maps 969G and 979G) indicate that this is a peripheral unit, most likely an arcuate mass, which does not completely enclose the syenite core.

The complex is composed largely of coarse-grained syenitic rocks of a pinkish grey colour. The syenitic rocks are equigranular to inequigranular porphyritic and composed of 70 to 90 percent potassium feldspar and black interstital amphibole. The rocks locally display trachytoidal textures which impart a foliation parallel or subparallel to the general outline of the pluton. The syenitic rocks of the periphery of the body do not appear to differ from those at the core.

A prominent lineament occurs along the northwest corner of the complex and fine-grained, leucocratic, pink aplitic granite cuts the syenitic rocks along and parallel to this trend.

K. Bell and D. Watkinson of Carleton University (unpublished data) reported a K-Ar isotope age of 2534± 147 m.y. for the complex. This age is likely a minimum age even though the complex visually appears relatively unmetamorphosed.

STRUCTURAL GEOLOGY

The Wapikopa Lake alkalic complex lies within the Gods Lake Subprovince of the Superior Province. The lack of exposure of rocks enclosing the complex in conjunction with a lack of prominent features on aeromagnetic maps covering the complex (ODM-GSC aeromagnetic maps 969G and 979G) prevents any interpretation as to its possible relationship to regional structures.

Trachytoidal textures within the syenite portion of the pluton display trends that are generally tangential to the outline of the complex and steeply dipping. Rarely, mafic segregations within the syenitic rocks impart a banding to the rock which is parallel to the trachytoidal texture.

PREVIOUS WORK

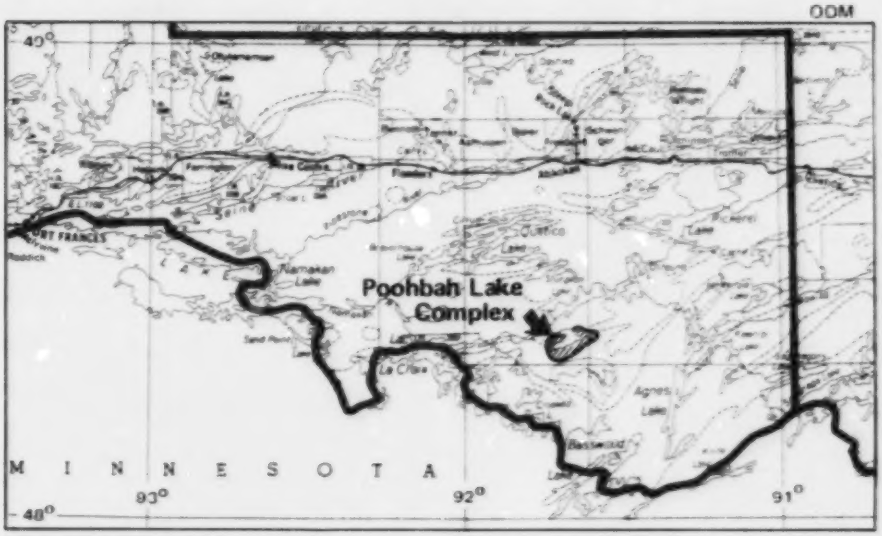
The location and general shape of the Wapikopa Lake alkalic complex was first recorded by Emslie (1962) and Bostock (1962). Their work was part of a regional geologic reconnaissance program and the description of the syenite complex is part of the marginal notes accompanying the regional maps resulting from that work.

RECOMMENDATIONS FOR THE PROSPECTOR

Sulphide mineralization was not observed within this complex. Carbonatitic rocks were not found and evidence for the presence of fenites is lacking. Apatite in concentrations approaching a visually estimated 15 percent by volume occurs in some of the rocks collected from the mafic phase of the complex on the southwest flank of the intrusion. This area of the complex may warrant some additional prospecting for the presence of accumulations of apatite. Large areas of the complex are drift covered and cannot be evaluated on the basis of field work. Except for the possibility of there being a local accumulation of apatite, the examination of available outcrop was not encouraging as to the possible mineral potential of this complex.

POOHBAH LAKE ALKALIC ROCK COMPLEX

DISTRICT OF RAINY RIVER



LOCATION MAP C

Scale: 1:1,584,000 or 1 inch to 25 miles

LOCATION AND ACCESS

The Poohbah Lake alkalic rock complex lies approximately 19 km (12 miles) north of the United States-Canadian border within Quetico Provincial Park. The center of the complex lies at approximately 48°22'30"N Latitude and 91°42'W Longitude. Poohbah Lake can be reached by portaging up Poohbah Creek from the Maligne River or by fixed-wing aircraft from the Ontario Ministry of Natural Resources base at Nym Lake located approximately 5 km (3 miles) southeast of Atikokan. The complex covers an area of approximately 49.8 km^2 (19.4 square miles) centered on Poohbah Lake. Outcrop is not abundant, and is concentrated in the northern half of the complex, principally along the shoreline of Poohbah Lake. Scattered outcrops are also present away from the shore of the lake.

MINERAL EXPLORATION

There is no record of mineral exploration activity on the complex in the Assessment Files

Research Office of the Ontario Division of Mines. Trace to very minor amounts of pyrite occur in schistose inclusions of wall rocks, but sulphides are not visually identifiable in rocks of the complex. Apatite in concentration visually estimated by the author to approach 10 to 15 volume percent occurs as a accessory component to the more mafic (malignitic) phases of intrusion. The apatite content is highly variable and the complex is not likely to contain economic concentrations of this mineral. The complex lies within the boundaries of the Quetico Provincial Park and sampling of the outcrops as well as flying into the area requires permission of the Director of Parks Branch, Ontario Ministry of Natural Resources.

GENERAL GEOLOGY

The Poohbah Lake complex consists fundamentally of two rock types: malignite, and syenite, which have been emplaced into biotite-quartz-plagioclase and hornblende-biotite schists of the Quetico Subprovince of the Superior Province. Mitchell (1975) reported a K-Ar radiometric age of 2558 m.y. on samples collected from the complex. This age would be a minimum age for the body. The general northeast-southwest elliptical outline of the body is well illustrated on ODM-GSC aeromagnetic map 1131G.

The malignitic rocks (nepheline plus pyroxene plus potassium feldspar) occur as roughly arcuate medial units enclosed within an outer unit of coarse- to very coarse-grained syenite. The malignites in turn enclose coarse- to very coarse-grained syenite of the core similar to the outer unit. There is visually no identifiable textural, compositional, or age differences between the outer and inner coarse-grained syenites.

The malignites are dark greenish black to black, fine- to medium-grained mafic rocks which on weathered surface may display a slightly pitted surface from the weathering out of the nepheline. Apatite is a common accessory mineral.

The syenites are coarse to very coarse grained with an interstitial amphibole matrix constituting 10 to 30 percent of the rock. The exposures with the higher mafic content contain the larger feldspar crystals and best display trachytoidal textures which are common throughout the syenitic phases of the body. Rarely, mafic segregations impart a weak banding to the syenite which is conformable with feldspar orientations.

On a lake in the northwest corner of the complex one outcrop of mafic intrusive (?) breccia was found.

Along the southeastern and eastern flanks, the complex has been cut extensively by very coarse-grained, pale pink, feldspar and quartz granite pegmatite. The pegmatite intrusions are in sharp contact with the syenite.

No evidence of carbonatite intrusions or development of fenite in the enclosing wall rocks was observed by the mapping party.

STRUCTURAL GEOLOGY

Trachytoidal textures, as defined by the preferred orientation of the feldspars and rare mafic segregation bands, parallel the northeast-southwest elliptical elongation of the intrusion. Schistosities within the enclosing schists are conformable with the outline of the intrusion.

The dips on the trachytoidal rocks are steep along the flanks, but somewhat shallower towards the core. Dips within the schists are vertical along the north side, steeply dipping to the east along the west flank and steeply dipping to the north along the south flank. Inward dipping trachytoidal foliations along the eastern margin of the complex, in conjunction with structural trends found in the wall rocks, imply a funnel shaped intrusive body.

Field observations suggest that the body has been subjected to little tectonic activity and is relatively unmetamorphosed.

PREVIOUS WORK

The Poohbah Lake complex became prominent in geological literature from the work of Lawson (1896) who on the basis of samples collected at Poohbah Lake described and defined a rock type: malignite. The Poohbah Lake complex is thus the type locality for this rock.

Allen (1942) completed additional work on the malignites defining the associated rock types, and prepared a map outlining the intrusive complex.

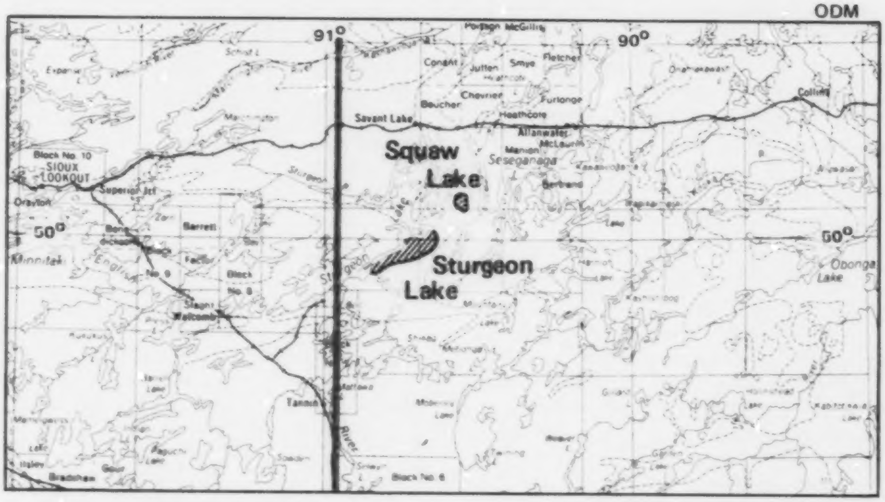
Tanton (1937) prepared a reconnaissance map of the area indicating the general regional setting of the complex.

RECOMMENDATIONS FOR THE PROSPECTOR

The Poohbah Lake complex lies within the boundaries of Quetico Provincial Park and is closed to staking.

STURGEON NARROWS AND SQUAW LAKE ALKALIC ROCK COMPLEXES

DISTRICT OF THUNDER BAY


ODM
91°
90°
50°
50°
Savant Lake
Block No. 10
SIOUX LOOKOUT
Superior Jct
Collins
Allanwater
Seseganaga
Squaw Lake
Sturgeon Lake
Obonga Lake

LOCATION MAP D

Scale: 1:1,584,000 or 1 inch to 25 miles

LOCATION AND ACCESS

The Sturgeon Narrows alkalic rock complex is located on the east side of Sturgeon Lake at the approximate Latitude of 50°00'N and 90°43'W Longitude. The complex is readily accessible by boat from any one of several boat landings on the west shore of Sturgeon Lake. Roads to the boat landings run east from Highway 599 south of the small community of Savant Lake.

The Squaw Lake alkalic rock complex lies approximately 10 km (6 miles) northeast of the Sturgeon Narrows alkalic rock complex and can be reached by portaging up Vista Creek from Sturgeon Lake. Boats on Squaw Lake can be rented from the local lodge owners. The complex is at approximately 50°03'45"N Latitude, 90°33'W Longitude, and is centred on Squaw Lake.

Neither of the rock complexes are well exposed. The best outcrops of the Sturgeon

Narrows alkalic rock complex can be found at its southern end, on islands in Sturgeon Lake, at the northeast corner, and in the east central portion of the complex. Outcrops of the Squaw Lake intrusion are confined principally to the shoreline.

The Sturgeon Narrows complex is tadpole-shaped, elongated northeast-southeast with the "tail" pointing southwest. The complex covers a surface area of approximately 31 km^2 (12 square miles). The Squaw Lake intrusion is circular in outline and covers a surface area of approximately 4.5 km^2 (1.7 square miles).

The shape of these two alkalic rock complexes is best illustrated by the aeromagnetic contours on ODM-GSC aeromagnetic maps 1117G and 1118G.

MINERAL EXPLORATION

Little if any exploratory work has actually been done on the Sturgeon Narrows complex. Various exploration companies have conducted exploration programs covering the marginal areas of the intrusion and tested anomalies by diamond drilling in the metavolcanics and metasediments marginal to the complex (see Trowell 1976 and *in prep.*).

In 1974, Falconbridge Nickel Mines Limited, in 1975 Rio Tinto Canadian Exploration Limited (Riocanex) and in 1969 W.G. Wahl Limited conducted exploration programs in proximity to the Sturgeon Narrows complex[1]. Texmont Mines Limited and Green Point Mines Limited have conducted exploration programs which completed diamond drill programs in proximity to the southeast contact of the body. The Green Point Mines Limited program involved 13 holes totalling 641 m (2,136 feet) and the Texmont Mines Limited program involved 4 holes totalling 488 m (1,625 feet)[1].

There is no record of any exploration work on the Squaw Lake complex.

GENERAL GEOLOGY

Trowell (1976) subdivided the rocks of the Sturgeon Narrows complex into four groups, inner and outer syenite, inner leucosyenite, and syenogabbro-syenodiorite. The following summary of petrography is largely extracted from Trowell (1976 and *in prep.*). The inner and outer syenites are grey coloured, coarse grained, massive, equigranular, and consist of orthoclase, microcline-microperithite, altered nepheline, pyroxene and biotite. Minor interstitial plagioclase and garnet are also present. The mafic components vary from 10 to 25 percent of the rock. The outer syenites are more trachytoidal and have a higher mafic content than the inner syenites, otherwise the inner and outer syenites are the same and gradational into each other.

The inner leucosyenite is pinkish coloured, fine to coarse grained, equigranular porphyritic and consists of orthoclase perthite interstitial to plagioclase with minor muscovite, biotite, carbonate, sphene, pyrite, magnetite and apatite. Trowell (1976) on the basis of thin section examination classified rocks within this group as varying from syenite to monzonite.

The syenogabbro or syenodiorite occurs in the northeast corner of the complex and is pinkish coloured, medium to coarse grained, massive equigranular to slightly porphyritic. The rock is composed of plagioclase with a mafic content varying from 20 to 70 percent composed dominantly of pyroxene and biotite. This rock group contains accessory magnetite, sphene, and apatite and is cut by syenite dikes.

Trowell (*in prep.*) reported feldspathization and development of blue-green amphiboles along the margins of the Sturgeon Narrows intrusion and that this alteration is developed best on Seaton Island, Coveney Island and Middle Island at Sturgeon Narrows and is best seen in thin section rather than in outcrop. The author saw little visual evidence of alteration of the wall rocks in the exposures visited.

Spectrographic examination of carbonate samples collected from fracture fillings in the Sturgeon Narrows alkalic rock complex failed to disclose significant trace element concentrations characteristic of carbonatites and thus the source of the carbonate fillings is not likely carbonatitic intrusions (Trowell *in prep.*).

The rocks of the Squaw Lake intrusion have been divided by Trowell (*in prep.*) into two broad groupings. These groupings are coarse-grained to pegmatitic alkalic phases of syenite and monzonite in the north half of the intrusion and medium-grained, equigranular and quartz-bearing syenite, syenomonzonites and monzonite of the south half. Trowell (*in prep.*) reported a 60 m (200 feet) zone of contact metamorphism and metasomatism enveloping the Squaw Lake complex similar to the contact zone of the Sturgeon Narrows complex.

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[1] Information from Assessment Files Research Office, Ontario Division of Mines, Toronto.

Trowell (*in prep.*) considered that the Sturgeon Narrows alkalic complex and the Squaw Lake complex are probably comagmatic; the author concurs with this.

STRUCTURAL GEOLOGY

The Sturgeon Narrows and Squaw Lake alkalic complexes are enclosed within the Sturgeon Lake metasedimentary-metavolcanic belt which lies within the Wabigoon Subprovince of the Superior Province.

Trowell (1976 and *in prep.*) on the basis of his regional studies concluded that the Sturgeon Narrows alkalic rock complex was emplaced along a fault zone in metasediments, or along a metavolcanic-metasedimentary contact. On the basis of cross-cutting aeromagnetic pattern, step-like ridges in the metavolcanic rock on the west side of Sturgeon Narrows and cataclastic textures in the syenitic rocks on the east shore of Sturgeon Narrows, Trowell (1976) places a major fault or shear zone along the west side of the complex and down the medial line of Sturgeon Narrows. The author observed narrow protomylonite zones up to 1 m (3 feet) in width, crushed and rotated feldspar crystals within the syenite in numerous areas along the east shore of the Sturgeon Narrows complex, and concurs with Trowell's (1976) interpretation.

The immediate contacts of the Sturgeon Narrows intrusion are generally concordant with the enclosing wall rocks, and trachytoidal textures in the syenite, generally conform to the outline of the intrusion (Trowell 1976).

The Squaw Lake intrusion is conformable with the enclosing metavolcanics and metasediments and trachytoidal textures within the alkalic rocks are tangenital to the margins of the pluton (Trowell *in prep.*).

Both the Squaw Lake and Sturgeon Narrows intrusions display protoclastic textures in thin section (Trowell *in prep.*). The trachytoidal textures and protoclastic textures are interpreted by Trowell and the author as primary intrusive features.

PREVIOUS WORK

Miller (1903, p.104-105), Moore (1911, p.155), Gledhill (1923, p.33-38), Graham (1930, p.43-44), Rogers (1964, p.27-30), and Trowell (1976 and *in prep.*) have all written descriptions of the Sturgeon Narrows alkalic complex. Gledhill (1923, p.36), Graham (1930, p.43) and Trowell (*in prep.*) have described the Squaw Lake intrusion.

RECOMMENDATIONS FOR THE PROSPECTOR

The Sturgeon Narrows alkalic rock complex has been covered by airborne electromagnetic and magnetic surveys without disclosing anything of interest[1]. Mapping by Trowell (1976 and *in prep.*) and the author has disclosed barren sulphides in only trace to minor quantities. The fluorite veins or fracture fillings in the Sturgeon Narrows complex are narrow and short. Apatite in rocks of the complex rarely attains a visually estimated 1 volume percent. The nepheline is highly altered along the western side of the body. Nepheline is much fresher in the eastern half of the body but some slight alteration is also present. Although it is possible that a zone of nepheline syenite of potential economic interest may exist in the eastern part of the intrusion, the chances are not as good as in other alkalic rock plutons. Those seeking economic mineral deposits in the area of the Sturgeon Narrows complex would best concentrate on the enveloping metasediments and metavolcanics.

The Squaw Lake intrusion is largely covered by the waters of Squaw Lake preventing an assessment of its true potential. It would tentatively appear that the same critique that applys to the Sturgeon Narrows complex (with the exception of nepheline) would also apply to the Squaw Lake complex. The nepheline content of the Squaw Lake intrusion appears to be much less than that of the Sturgeon Narrows complex.

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[1] Information from Assessment Files Research Office, Ontario Division of Mines, Toronto.

CARGILL TOWNSHIP CARBONATITE COMPLEX

DISTRICT OF COCHRANE

LOCATION AND ACCESS

The Cargill Township intrusion (location map E) is located at approximately 49°19'N Latitude and 82°49'W Longitude. The complex is located in the northwest corner of Cargill Township and extends into the southwest corner of Cumming Township. The complex can be reached most easily by the private logging access road of Spruce Falls Pulp and Paper Company Limited which passes within 1.5 km (1 mile) of the body. The International Minerals and Chemical Corporation (Canada) Limited have constructed a subsidary road from that of the pulp company to their campsite on Marilyn Lake (local name) located on the southern half of the complex.

The complex is dumbell shaped and has a pronounced elongation in the northeast-southwest direction. Its general outline is well displayed on ODM-GSC aeromagnetic map 2252G. The intrusion has a surface area of approximately 9.6 km^2 (3.7 square miles). Outcrop on the complex is rare, and consists of several small deeply weathered outcrops of pyroxenite and/or carbonatite. The body lacks any topographic relief and is locally covered by marshy ground.

MINERAL EXPLORATION

The earliest recorded work on this complex was by the Continental Copper Mines Limited who in 1955 completed seven diamond drill holes totalling 931 m (3,102 feet) to test magnetic anomalies discovered by a ground magnetometer survey for base metals[1]. In 1964 Kennco Explorations (Canada) Limited optioned the property from Continental Copper Mines Limited for the purpose of examining the property for copper-nickel base metal mineralization. After a brief examination of the property Kennco dropped the option[2]. Again, in 1970 Kennco re-evaluated the available data on the Cargill intrusion, re-optioned the ground held by Continental Copper Mines Limited, staked additional claims, and proceeded with additional testing of the complex's base metal potential. The company completed assays on soil, rock, and diamond drill core and drilled six diamond drill holes totalling 1089 m (3,486 feet)[2].

In 1969, Union Carbide Canada Mining Limited staked claims west of the ground held by Continental Copper Mines Limited. W.G. Wahl Limited re-evaluated previously existing data on the complex for Union Carbide Canada Mining Limited and recommended two diamond drill holes to test the base metal potential (files, Union Carbide Canada Mining Limited donated to Assessment Files Research Office). This company did not complete the recommended work.

In 1974, the International Minerals and Chemical Corporation (Canada) Limited, as part of its exploration program of evaluating carbonatite complexes as a source of phosphorous, re-evaluated all existing data on this complex (Sandvik and Erdosh 1976). The company optioned the claims held by Continental Copper Mines Limited and staked additional ground. The company at this time hoped to locate residual apatite concentrations of economic value within a karst-like topography developed on the surface of a carbonatite intrusion (Sandvik and Erdosh 1976). The company completed 190 holes using reverse circulation techniques and outlined a residual phosphate-bearing deposit of 62.5 million tons with an average grade of 19.6 percent P_2O_5 (Sandvik and Erdosh 1976). The company is currently undertaking feasibility studies to determine if the property can be profitably worked (Sandvik and Erdosh 1976).

GENERAL GEOLOGY

The Cargill Township complex, as indicated by ODM-GSC aeromagnetic map 2252G, is a dumbell-shaped body approximately 7.2 km (4.5 miles) long with two pronounced aeromagnetic anomalies separated by a narrow band

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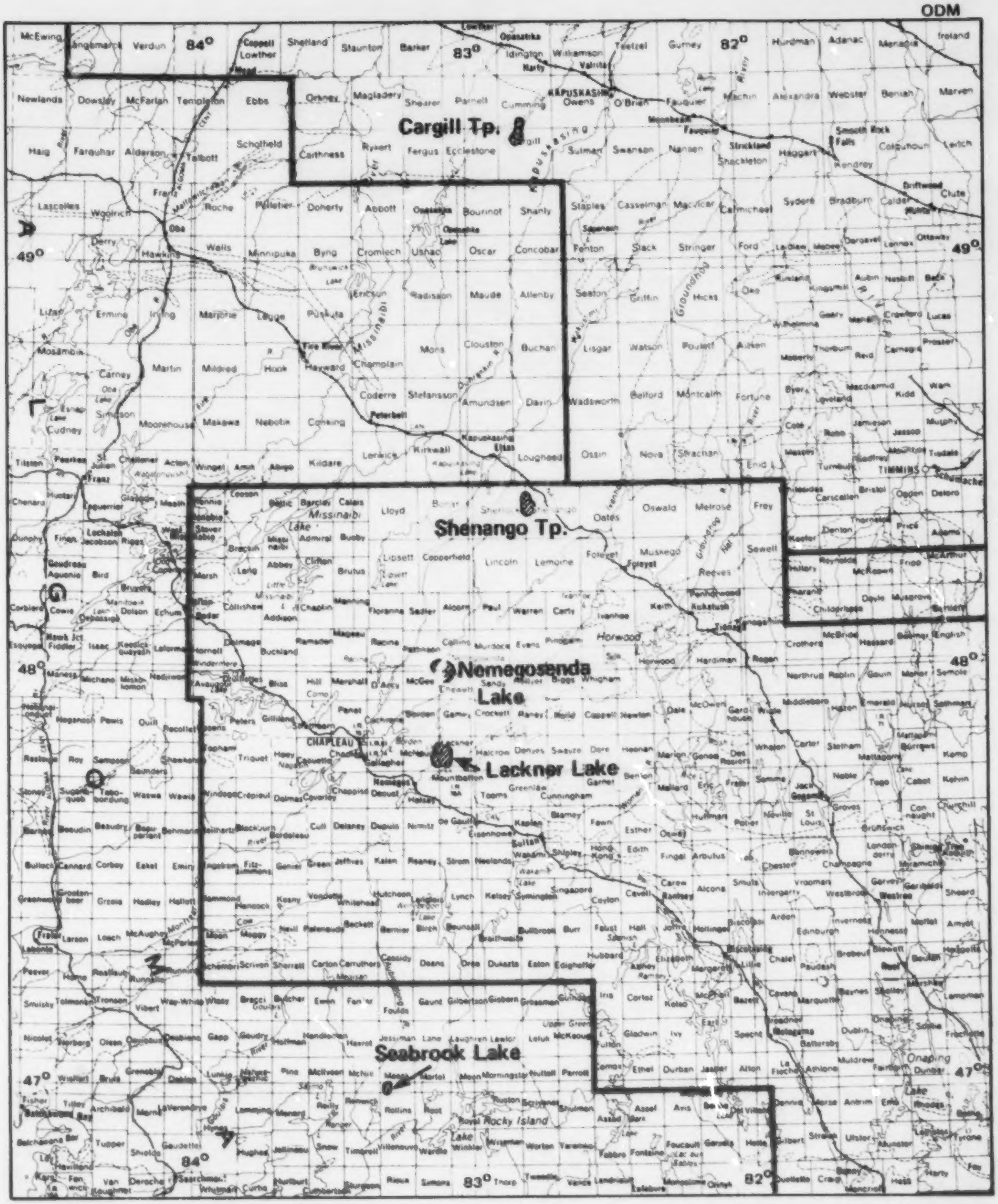
[1] Information from Assessment Files Research Office, Ontario Division of Mines, Toronto.

[2] Information from files donated to the Assessment Files Research Office by Kennco Exploration (Canada) Limited.


ODM
Cargill Tp.
Shenango Tp.
Nemegosenda Lake
Lackner Lake
Seabrook Lake
CHAPLEAU
KAPUSKASING
TIMMINS
49°
48°
47°
84°
83°
82°

LOCATION MAP E

Scale: 1:1,584,000 or 1 inch to 25 miles of lower aeromagnetic intensity. The two pronounced aeromagnetic anomalies may be the faulted portions of a once continuous, more circular body (Bennett *et al.* 1967; Sandvik and Erdosh 1976). The International Minerals and Chemical Corporation (Canada) Limited have named these two anomalies north and south subcomplexes and a third aeromagnetic anomaly 4 km (2.5 miles) west of the main intrusive mass as the west subcomplex (Sandvik and Erdosh 1976).

The Cargill Township complex is enveloped in Early Precambrian quartz diorite gneiss and amphibolite (Sandvik and Erdosh 1976). Drilling by the International Minerals and Chemical Corporation (Canada) Limited indicated that the complex consists of arcuate to curvilinear bands of siderite, calcite, and dolomite carbonatite enclosed in a wide unit of pyroxenite and hornblendite (Sandvik and Erdosh 1976). The carbonatite is multi-phased and zoned; the outer zone of carbonate rock is calcite carbonatite and the core is dolomite carbonatite (Sandvik and Erdosh 1976). Siderite phases, which are probably the latest, intrude the earlier carbonate phases as arcuate or lens-shaped bodies (Sandvik and Erdosh (1976).

Sandvik and Erdosh (1976) reported that fenitization is absent in quartz diorite rocks lying in contact with the complex to the south but are distinctly present at the west subcomplex lying 4 km (2.5 miles) west of the main intrusive body.

Data reported by Allen (1972) would indicate that the complex is about 1800 m.y. old.

The apatite-bearing residuum developed from weathering of the carbonatite forms the phosphate reserves drilled by the International Minerals and Chemical Corporation (Canada) Limited (Sandvik and Erdosh 1976). The residuum is light to dark grey, in places brownish, unconsolidated material predominantly of sand size grains made up of white to colourless crystals, crystal fragments, and rounded grains of apatite (Sandvik and Erdosh 1976). Sandvik and Erdosh (1976) reported that the residuum ranges up to 100 percent apatite. The residuum in many places is diluted with clay, vermiculite, iron oxide, goethite, quartz, and chlorite (Sandvik and Erdosh 1976).

A crandallite-rich blanket near the top of the apatite residuum is high in rare earth values which may ultimately prove of economic interest (Sandvik and Erdosh 1976). Sandvik and Erdosh (1976) reported that the apatite residuum may exceed 170 m (570 feet) in thickness in pre-glacial troughs within the carbonatite complex, and be only a few metres thick on ridges between the troughs.

Even though apatite is present in all phases of the complex the proto-ore for the apatite residuum is principally sideritic and dolomitic carbonatite (Sandvik and Erdosh 1976).

STRUCTURAL GEOLOGY

The Cargill Township complex lies within the Kapuskasing Subprovince of the Superior Province. This subprovince is characterized geophysically as a northeast-trending zone of gravity highs and pronounced linear aeromagnetic trends (Innes 1960; ODM-GSC 1970b). This anomalous gravity zone has been interpreted as an upwarp in the Conrad discontinuity caused by major regional faulting and the formation of a complex horst structure (Wilson and Brisbin 1965; Bennett *et al.* 1967) This prominent regional structure extends from the south end of Hudson Bay southwestward, becoming broader and more ill-defined as it approaches the Lake Superior basin. The Cargill Township complex has been emplaced into this structure, which also contains many other carbonatite alkalic complexes north and south of Cargill Township.

The dumbell shape of the complex may have resulted from right lateral displacement along a northeast-trending fault that cuts the complex; strike-slip movement is approximately 4.0 km (2.5 miles) (Sandvik and Erdosh 1976). The fault may have been a pre-intrusive feature which controlled the emplacement of the carbonate and later became re-activated (Sandvik and Erdosh 1976). Some evidence of post-emplacement adjustment along the fault is the presence of unfenitized quartz diorite gneiss in contact with the southern subcomplex and along the strike of the interpreted fault zone, and the presence of visible fenitization peripheral to the west subcomplex which lies away from the fault (Sandvik and Erdosh 1976). This distribution of fenitized rock suggests that the quartz diorite gneiss marginal to the south subcomplex was not originally in direct contact with the intrusion at the time of its emplacement.

Sandvik and Erdosh (1976) reported that along the contact zone, interbanded carbonatite and pyroxenite, varying from a few centimetres to several metres thick are steep to vertical in dip. In examination of a limited amount of (International Minerals and Chemical Corporation (Canada) Limited) diamond drill core, the writer noted that mineralogic banding in the carbonate phases was parallel to, or closely parallel to the axis of the core which was obtained from vertical holes.

PREVIOUS WORK

Bennett *et al.* (1967, Figure 13) prepared the first map of the complex. The investigation at this time was very brief for it was part of a large scale regional reconnaissance program. Allen (1972) completed detailed studies on the mafic rocks of the complex using samples of diamond drill core obtained from Kennco Explorations (Canada) Limited.

RECOMMENDATIONS FOR THE PROSPECTOR

Rare earth and vermiculite may exist in sufficient concentrations to be economic by-products of a phosphate mining operation, and need further evaluation. Disseminated pyrrhotite in amounts up to 5 percent was observed by the writer in the carbonatite phases of the complex, however, sulphides of economic interest were not observed. Disseminated, fine-grained pyrite, pyrrhotite, and chalcopyrite are common in the pyroxenite-amphibolite phases. Even though the assay and drilling results of Kennco Explorations (Canada) Limited and Continental Copper Mines Limited are far from encouraging, the possibility that local accumulations of disseminated sulphide mineralization of potential economic interest may occur in the pyroxenitic-amphibolitic phases of the complex and can not be totally discounted.

SHENANGO TOWNSHIP ALKALIC ROCK COMPLEX

DISTRICT OF SUDBURY

LOCATION AND ACCESS

The Shenango Township alkalic rock complex lies across the Shenango-Sherlock Townships boundary at approximately 48°24'N Latitude and 82°48'W Longitude. The complex is teardrop shaped, elongated northeast-southwest, and has a surface area estimated to be 66 km^2 (24 square miles). The teardrop-shaped complex narrows to the northeast and its general outline is displayed best on ODM-GSC aeromagnetic map 2248G. Access to the complex is by railway or float-equipped aircraft to Shiners Lake or Shenango Lake. Shenango Lake lies along the east flank of the complex and Shiners Lake lies on the north end of the intrusion. The main east-west line of Canadian National Railways crosses the complex at Shiners Lake.

Outcrop is absent or scarce along the western and southern margin of the intrusion. The best exposures are along the shore of Shiners Lake, in railway cuts on the Canadian National Railways right-of-way, and in the centre of the intrusion.

The surface of the complex is generally low and rolling with the exception of a large hill in the centre known as Bollo Hill (local name) and a second hill in the northeast corner of the body known as Cone Hill (local name). Of the two hills, Bollo is the highest, rising approximately 75 m (250 feet) above the typical undulating surface which characterizes most of the shield topography.

MINERAL EXPLORATION

In 1968 and 1969 Genesco Resources Limited completed line cutting, prospecting, geologic survey and magnetometer survey over the central portion of the complex. This work failed to disclose anything of interest.

Kennco Explorations (Canada) Limited in 1970 completed line cutting over the northern portion of the complex and re-examined some of the area covered by Genesco Resources Limited[1]. This work disclosed some sulphide mineralization containing copper values in an amphibolite unit forming a arcuate horseshoe-shaped unit within the interior of the complex[1]. These showings were not judged by the company to be worth follow-up work.

The company completed a magnetometer survey and induced polarization survey over portions of the property[1]. Two diamond drill holes totalling 302 m (1,006 feet) were drilled by the company in the northern portion of the complex, encountering amphibolitic and monzonitic rocks. The holes were barren and the company terminated its activity in the area.

Representatives of the International Minerals and Chemical Corporation (Canada) Limited examined portions of the complex in 1974 but were not encouraged and suspended further activity (files, International Minerals and Chemical Corporation (Canada) Limited, donated to Assessment Files Research Office).

Mapping by members of this field party failed to locate sulphide mineralization in rocks of the complex, but confirmed the presence of minor pyrite mineralization in the amphibolites. The sulphide content is generally low and not encouraging. The amphibolite is highly metamorphosed and likely of Early Precambrian age and thus not related to the alkalic rocks of the complex which are Late Precambrian in age.

Rocks containing visually identifiable apatite or nepheline were not seen.

GENERAL GEOLOGY

The writer visited the complex briefly in 1970 as part of Operation Chapleau and a brief description of the complex is contained in the report (Thurston *et al.* 1974). Work during this past field season would modify some details of the early interpretation (Thurston *et al.* 1974).

The complex consists of diorite to syenodiorite, monzonites and granitic rocks. Trace element analyses (Thurston *et al.* 1974) indicated unusually high concentrations of barium and strontium in these rocks, typical of alkalic complexes. A K-Ar isotopic age of 1065 ± 24 m.y. (K. Bell and D. Watkinson, Carleton University, 1972, unpublished data), which is equivalent within experimental error to other K-Ar isotopic ages of carbonatite-alkalic complexes within the Kapuskasing Subprovince also implys that rocks of this complex are intimately related to other alkalic intrusive events within this subprovince.

The diorite to syenodioritic rocks can be easily divided into two map-units. On Shiners Lake and extending southwestward from the lake is a large body of pinkish grey to buff, coarse-grained massive alkalic diorite. The rock is equigranular and locally has a weak trachytoidal texture. In the vicinity of Shenango Lake, west of Shenango Lake, and in a rock cut for the Canadian National Railway immediately east of Shiners Lake, is a fine-grained massive equigranular syenodiorite. Rocks of this fine-grained unit appear to be arcuate masses intruded in *lit-par-lit* fashion into the gneissic rocks of the Kapuskasing Subprovince. This unit was not observed in contact with the coarse-grained alkalic diorite. The fine-grained syenodiorite commonly contains coarse-grained pegmatitic fracture fillings of monzonitic to granitic composition.

The monzonitic rocks intrude the alkalic diorite and have sharp contacts. The rocks are red to reddish brown in colour, massive, highly variable in grain size, equigranular, and contain a dark green to black, somewhat acicular amphibole. This rock type generally occurs as small masses and dikes, and locally forms a pegmatitic phase in some exposures along the Canadian National Railway right-of-way.

The granitic phases are bright red to reddish brown, generally very fine grained, leucocratic, and best described as aplite. This unit rarely forms dikes or masses of mappable size and sharply cross-cuts the dioritic and monzonitic phases.

The amphibolite band that forms the curvilinear unit within the complex has a minor quantity of magnetite associated with it which gives rise to the prominent horseshoe-shaped anomaly on ODM-GSC aeromagnetic map 2248G. The amphibolite displays good metamorphic textures in thin section and is likely of Early Precambrian age and unrelated to the fresh looking alkalic rocks (Thurston *et al.* 1974). Elliptical clots of quartz and epidote in some units suggest that the amphibolite may be a series of amygdaloidal flows.

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[1] Information from files donated to the Assessment Files Research Office by Kennco Exploration (Canada) Limited.

D. Watkinson of Carleton University (personal communication, 1976) is presently conducting detailed microprobe and thin section studies on the amphibolites and alkalic rocks of the complex.

Neither carbonatites nor fenitized rocks were observed.

STRUCTURAL GEOLOGY

The Shenango Township alkalic rock complex lies within the Kapuskasing Subprovince (see above under Cargill Township complex) of the Superior Province.

The alkalic rocks are unmetamorphosed and undeformed in contrast to the amphibolite within the interior of the complex and the granulite-facies rocks surrounding the complex. The lack of deformation and metamorphism implies that the rocks were emplaced as phacolithic-intrusions into the highly metamorphosed rocks. Several outcrops interpreted as metagabbro and garnet-bearing metagabbro occur along the east and south flanks and appear similar to outcrops of the Shawmere anorthosite complex (Thurston *et al.* 1974). The rocks of these two complexes may therefore be in contact with each other. Tentatively the Shenango Township complex may represent a series of alkalic rocks emplaced as phacolithic intrusions into a fold structure within gneissic rocks bordering the Shawmere anorthosite complex. The regional setting of the complex requires additional work.

RECOMMENDATIONS FOR THE PROSPECTOR

Sulphide mineralization of potential economic interest was not observed by this field party, nor was mineralization of the type found in other nearby alkalic complexes. The Shenango Township alkalic rock complex represents a more silica-saturated series of rocks than those found in the nearby alkalic rock complexes, and this fundamental difference in rock chemistry compared to the other alkalic rock complexes found within the Kapuskasing subprovince is not encouraging for the location of similar mineralization. The greater economic potential of the area would appear to lie within the gneissic rocks, both within and outside of the complex, rather than the alkalic rocks themselves.

NEMEGOSENDA LAKE ALKALIC ROCK COMPLEX

DISTRICT OF SUDBURY

LOCATION AND ACCESS

The Nemegosenda Lake alkalic rock complex (location map E) lies principally in Chewett Township; but lesser portions of the complex are located in Collins, Patterson, and McGee Townships. The complex is centred at approximately 48°00′N Latitude and 83°06′W Longitude with Nemegosenda Lake occupying the core area of the body.

Highway 129 passes within 5 km (3 miles) of the complex and a still driveable abandoned logging access road approaches within 2 km (1 mile) of the eastern shore of the lake. Access to the complex is best by float-equipped fixed wing aircraft which can be chartered in Chapleau approximately 24 km (15 miles) south of the complex. A lodge on the southwest corner of the lake can provide boats, accommodations and meals.

The complex is slightly elongated in the north-south direction and its general shape is best illustrated by the somewhat oval shaped aeromagnetic anomaly on ODM-GSC aeromagnetic maps 2233G and 2232G. Outcrop is not abundant on the complex; most is found along or close to the shore of Nemegosenda Lake. The complex does not have a prominent topographic expression, the undulating surface being typical of shield topography. The complex has a surface area of approximately 18 km^2 (7 square miles).

MINERAL EXPLORATION

The Nemegosenda Lake alkalic rock complex was intensely prospected by the Dominion Gulf Company between 1955 and 1959. The company completed a diamond drill program of 68 holes for a total of 10 592 m (35,306 feet) and drove a 174 m (580 feet) adit to obtain a bulk sample of a zone of niobium mineralization for metallurgical testing. The work of the company outlined a mineralized zone in the northeast corner of the complex containing 20,000,000 tons grading 0.47 percent Nb_2O_5 (Parsons 1961). Several additional zones of niobium mineralization were located along the east flank of the intrusion (Parsons 1961). The niobium mineralization occurs in mafic phases (predominantly malignite) and fenitized rocks of the complex (Parsons 1961).

GENERAL GEOLOGY

The Nemegosenda Lake alkalic complex consists largely of fine- to medium-grained syenitic to malignitic rocks which are bordered along their southern margin by an arcuate mass of coarse-grained nepheline syenite (Parsons 1961). The complex is enclosed within a fenitized envelope derived from the complex and country rocks (Parsons 1961). Ijolitic rocks occur in the northwest corner of the complex and gabbro forms a mass along the northwest margin and an isolated band along the east flank (Parsons 1961). Parsons noted the fresh unmetamorphosed nature of the gabbro units and classified them as part of the country rocks. The author would classify them as an early phase of the alkalic magmatism perhaps analogous to the gabbroic borders found on the Port Coldwell and Killala Lake complexes located north of the northeast corner of Lake Superior.

The alkalic rocks of the complex are cut by numerous unsubdivided lamprophyric dikes, porphyritic syenite dikes, and rusty brown weathering carbonate dikes. Rocks marginal to the carbonate dikes are bleached and altered and the carbonate dikes may in part occupy fractures or shear zones in the complex.

Parsons (1961) considered that the main area of mineralization in the north end of the complex represents a contact phenomena between the intrusive syenite and fenite. The mineralization resulted from the alteration accompanying the intrusion of mafic malignitic rocks into a breccia zone along the syenite-fenite contact (Parsons 1961). The brecciated nature of this mineralized zone is readily seen on samples lying on the waste dump at the mouth of the adit and is well illustrated by diagrams in the report by Parsons (1961).

STRUCTURAL GEOLOGY

The Nemegosenda Lake alkalic complex lies within the Kapuskasing Subprovince (see above under Cargill Township complex) of the Superior Province.

Parsons (1961) inferred from geophysical surveys, a number of faults within the complex. Shearing along the long axis of the lake may be indicated by the depth of Nemegosenda Lake, greater than 69.0 m (230 feet) (personal communication, G. Mains, lodge owner on Nemegosenda Lake), and by an inflection in trends of the gneissic banding of the amphibolites at the south end of the lake. Displacement along this proposed shear zone cannot be assessed because of the lack of marker horizons, and the lack of obvious deflections or trends in the aeromagnetic pattern.

Schistosities and gneissosities in country rocks along the abandoned logging road on the east side of the complex approximately follow the outline of the complex, as indicated by Parsons (1961).

PREVIOUS WORK

Sargent (1957) completed the first study of the alkalic rocks on Nemegosenda Lake and Parsons (1961) prepared a report and map covering the complex for the Ontario Department of Mines. Some of the outcrops on Nemegosenda Lake were examined during Operation Chapleau (Thurston *et al.* 1974).

RECOMMENDATIONS FOR THE PROSPECTOR

Drilling by the Dominion Gulf Company on the main niobium-bearing zone in the northeast corner of the complex has adequately delineated this mineralization. Additional drilling of niobium-bearing zones along the east flank would not likely add significant tonnages. Prospecting of ijolitic and malignitic rocks in the northwest corner of the complex for apatite and niobium may be warranted. Dominion Gulf completed little work in the southern and southeastern corner of the complex and additional prospecting in this area for apatite and nepheline in the coarse-grained nepheline syenite phases may be warranted. A sample of coarse-grained nepheline syenite containing poikilitic interstitial apatite collected from the larger of the two islands at the south end of Nemegosenda Lake returned 3.81 percent P_2O_5 and 24.1 percent Al_2O_3 (Thurston *et al.* 1974). Prospecting for extensions of this apatite-bearing nepheline syenite unit or delineation of similar rocks on the nearby mainland is perhaps warranted.

LACKNER LAKE ALKALIC ROCK COMPLEX

DISTRICT OF SUDBURY

LOCATION AND ACCESS

The Lackner Lake complex (location map E) is located in Lackner and McNaught Townships and centered at approximately 47°47'N Latitude and 83°06'W Longitude. The complex has a surface area of approximately 28 km^2 (11 square miles). The complex can be reached most easily by a gravel road that turns off Highway 129 approximately 16 km (10 miles) south of Chapleau. This gravel road runs in a general north to northeasterly direction from Highway 129 for a distance of approximately 39 km (22 miles), and terminates at the Multi-Minerals Limited property located in the southwest corner of the complex. A driveable trail exists from the southwest corner of the complex to an abandoned Division of Lands fire tower on the north side of the complex. Some of the trails and/or roads shown by Parsons (1961) are no longer passable.

Outcrop on the complex is not abundant even though this complex is probably the best exposed of the carbonatite-alkalic complexes in the Kapuskasing Subprovince. Outcrop is most abundant along the west and north sides of the complex. The centre, south, and east sides have only the occasional isolated outcrop. The complex forms a prominent topographic high, with hills rising 150 m (500 feet) above the typical, undulating shield topography.

MINERAL EXPLORATION

With the possible exception of the Port Coldwell alkalic rock complex the Lackner Lake complex has been the most intensively prospected alkalic rock complex in Ontario. The volume of data currently available for this complex is briefly summarized in Tables 1, 2 and 3 . For details of early exploration, the reader should refer to Parsons (1961), and for subsequent work, to the files of the Assessment Files Research Office of the Ontario Division of Mines.

In 1970 Multi-Minerals Limited zone No.6 was optioned to Fetio Industrial Developments Limited for the production of iron-titanium and phosphate concentrates (Canadian Mines Handbook 1972-1973, p.232). The company produced approximately 1,500 tons of concentrate which was shipped to the United States for metallurgical testing (personal communication, H.A. Pearson, vice president exploration, Multi-Minerals Limited).

Option arrangements with Fetio Industrial Development Limited terminated in December 1973 and the entire property was subsequently optioned to Mertec Resource Development Limited in March 1974 (Canadian Mines Handbook 1974-1975, p.232-233). The option arrangement with Mertec was terminated in May 1975 (Canadian Mines Handbook 1975-1976, p.190).

GENERAL GEOLOGY

The shape of the Lackner Lake complex is well illustrated on ODM-GSC aeromagnetic map 2232G by a strong, prominent, circular aeromagnetic anomaly over the intrusion. The anomaly is caused by concentrations of magnetite within

TABLE 1 EXPLORATION PROGRAMS AT LACKNER LAKE.

Company	Approximate date of work
Apagmag Mines Ltd.	1955
Chyka Mines Ltd.	1954
Claymac Mines Ltd.	1955
Dominion Gulf Co.	1954
Falconbridge Nickel Mines Ltd.	1959
MacDonald-Labrasseur-Derraugh	1952
Multi-Minerals Ltd.[1]	1954 to present
Ontario Rare Metal Mines Ltd.	1954
Silverman	1954, 1959
Union Carbide Canada Mining Ltd.	1969

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[1] Property held in the name of Nemegos Uranium Corp.

TABLE 2 SUMMARY OF DIAMOND DRILLING WITHIN AND MARGINAL TO THE LACKNER LAKE COMPLEX.

Company	No. of Holes	Footage
Apamag Mines Ltd.	5	2,130
Chyka Mines Ltd.	28	10,514
Claymac Mines Ltd.	9	2,722
Dominion Gulf Co.	3	
Falconbridge Nickel Mines Ltd.	14	3,336
MacDonald-Labrasseur-Derraugh	4	1,003
Multi-Minerals Ltd.		
A-Series	10	6,490
B-Series	10	6,269
C-Series	2	372
D-Series	1	1,610
E-Series	1	1,170
P-Series	31	4,393
R-Series	130	68,106
NX-Series	4	977
No letter	10	9,758
Ontario Rare Metal Mines Ltd.	4	2,068
Silverman	14	3,872
Union Carbide Canada Mining Ltd.	1	801
Total	281	127,608 (38,282 m)

the more mafic phases of the intrusion. Gittens *et al.* (1967) report a K-Ar age of 1090 m.y. for the complex.

The complex consists of a medial, arcuate partial ring of alkalic mafic rocks, ijolite and malignite, which separate similar appearing coarse- to very coarse-grained leucocratic nepheline syenites of the core and periphery of the complex. The peripheral and core syenites cannot be differentiated by mineralogy, textural or cross-cutting field relations. In proximity to the arcuate band of mafic rocks, the syenites are locally finer grained, have a strong to weak trachytoidal texture, and contain abundant subangular to subrounded mafic xenoliths. The xenoliths are locally derived from the more mafic phases of the complex which are cut by the nepheline syenites. The xenoliths are commonly biotite rich and some local reaction of the inclusions with the syenite magma may have occurred. Excellent exposures of the syenitic and mafic rocks occur in two canyons on the northeast rim of the complex (see Parsons 1961). In the southwest corner, diamond drilling by Multi-Minerals Limited has delineated two dike-like bodies of carbonate cutting the mafic phases of the complex. These carbonate bodies host part of the pyrochlore mineralization of Multi-Minerals zone 8. Parsons (1961) reported that carbonatite also occurs as float in the northeast corner of the complex.

Immediately northeast of the main Lackner Lake intrusion, a small subsidiary complex (Portage complex) occurs (Parsons 1961). This complex has little exposure, is composed entirely of alkalic mafic rocks, and was extensively drilled by Chyka Mines Limited in 1954.

TABLE 3 DIAMOND DRILL ESTIMATED RESERVES AT THE LACKNER LAKE COMPLEX.

Falconbridge Nickel Mines Ltd.[1]		
	Zone 1	2,000,000 tons grading 18.9% sol. Fe, 3.70% P
	Zone 2	500,000 tons grading 22.32% sol. Fe 2.89% P
Multi-Minerals Ltd.[2]		
	Zone 3-4	37,000,000 tons grading 21.3% apatite, 0.173% Nb_2O_5 to 500 foot depth
	Zone 6	5,024,250 tons grading 69.6% magnetite, 21.9% apatite to a 500 foot depth. Zone contains 2.72% rare earth oxides in the non-magnetic fraction, which is over 90 volume percent apatite.
	Zone 8	80,000,000 tons averaging 0.25 Nb_2O_5 to a depth of 800 feet

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[1] Files of Falconbridge Nickel Mines Ltd.; mineralized zones located in southeast corner of the complex, see Parsons (1961).

[2] Canadian Mines Handbook 1969-1970, p.241.

STRUCTURAL GEOLOGY

The Lackner Lake alkalic rock complex lies near the southern end of the Kapuskasing Subprovince (see above under Cargill Township complex).

In the southern portion of the complex Parsons (1961) delineated a number of small faults. Foliations observed by the author, principally trachytoidal textures, parallel the lithologic trends and circular outline of the complex and dip steeply inward.

PREVIOUS WORK

The Lackner Lake complex has been studied by several investigators. Hodder (1958) initially published a brief paper on the complex, and subsequently completed a more detailed study as part of a Ph.D. degree at the University of California (1960?). The results of this study were published by the Geological Survey of Canada (Hodder 1961). Other theses on the complex included that of Neczkar (1958) and Scott (1963).

Parsons (1961) prepared a report on this complex for the Ontario Department of Mines and the author wrote a brief description of the deposit as part of a regional reconnaissance mapping program (Thurston *et al.* 1974).

RECOMMENDATIONS FOR THE PROSPECTOR

Extensions to some of the mineralized zones of Multi-Minerals Limited, principally zone 8, appear to be possible. Large or additional deposits of massive magnetite and apatite such as Multi-Minerals zone 6 and perhaps deposits similar to the two small deposits located by Falconbridge Nickel Mines Limited in the southeast portion of the complex are not likely to be found because any magnetic anomalies of potential interest have already been drilled. Small lenses and dikes of magnetite and apatite are not uncommon but are not likely to form sufficient tonnage to make an ore deposit.

The large tonnages of low grade niobium mineralization found within the mafic phases of the intrusion will probably be of value in the near future but higher grade deposits in other areas are likely to be extracted first. The greatest potential for an economically viable operation would be the development of an extraction procedure that would recover several commodities from the same ore; i.e. apatite, magnetite, nepheline, and pyrochlore. Prospecting on the complex should be done with care, and leucocratic nepheline-rich areas within the nepheline syenite delineated and checked for the possible recovery of their nepheline content.

SEABROOK LAKE CARBONATITE COMPLEX

DISTRICT OF ALGOMA

LOCATION AND ACCESS

The Seabrook Lake carbonatite complex (location map E) is located in Maeck and Rollins Townships at approximately 47°00'N Latitude and 83°17'W Longitude. The complex is partially enclosed by the waters of Seabrook Lake and elongated in a north-south direction. Its general configuration is roughly outlined by ODM-GSC aeromagnetic maps 2228G and 2229G.

The complex has a surface area of approximately 1.5 km^2 (0.6 square miles); the northern extremity is bulbous and the complex narrows and tapers to the south.

Seabrook Lake can be reached by a forest access road running west from Highway 129 near Aubrey Falls to Tidy Bay on the east shore of Seabrook Lake. The surface of the complex forms a slight topographic high with respect to the surrounding ground. Several steep sided gulleys occur on the complex.

MINERAL EXPLORATION

The reader should refer to Parsons (1961) for a summary of early exploration of this complex.

In 1964, F.R. Joubin completed a geochemical survey of the complex and limited trenching, in search of niobium[1].

In 1971, Canpac Minerals Limited and Gunnex Limited completed a joint exploration program on the complex for niobium[1]. The companies cut a grid, completed geological mapping, a geochemical survey, a magnetometer survey, and a scintillation survey[1]. This work disclosed locally high niobium values and diamond drilling was recommended in three areas but not completed[1].

In 1974, International Minerals and Chemical Corporation (Canada) Limited examined the complex for apatite; the results of the survey did not encourage further exploration (files, International Minerals and Chemical Corporation (Canada) Limited).

GENERAL GEOLOGY

The Seabrook Lake carbonatite complex lies within the Abitibi Subprovince of the Superior Province. Gittens *et al.* (1967) reported K-Ar isotopic ages of 1109 and 1107 m.y. for the complex.

The complex consists predominantly of two rock types, carbonatite and ijolite. The carbonatite occurs in the northern portion of the complex, and is highly variable in texture and mineral content, and locally rich in hematite. Carbonate and biotite are the dominant megascopic minerals but pyroxene is locally present.

Extending southward from the carbonatite rocks is an elongated mass of nepheline-pyroxene rock mapped as ijolite. This rock unit is highly variable in composition ranging from pyroxenite (less than 10 percent nepheline) to pegmatitic segregations of urtite (greater than 70 percent nepheline). The rock is black to dark green in the pyroxene-rich phases to pale pink in the urtite phases. The unit is massive, medium to coarse grained, generally equigranular, and may contain up to 10 percent biotite.

Enveloping the carbonatite and ijolite is a zone of fenitized granite breccia. This unit consists of pink to reddish clasts of altered granite in a fine-grained dark matrix of altered and comminuted rock.

Outward from the altered granite breccia is a zone of fenitized granite about 300 m (1,000 feet) in width.

Away from the complex the granite is leucocratic, massive, coarse grained, equigranular, hypidiomorphic, and composed essentially of quartz (30 to 35 percent) and microcline with minor accessory biotite. The granite is typical of the late potassic granites of the Early Precambrian and is cut by a set of northwest-trending diabase dikes.

Small carbonate-rich dikes and locally inclusion-rich lamprophyric dikes cut the granitic rocks in several places.

STRUCTURAL GEOLOGY

The Seabrook Lake carbonatite complex does not occur within any prominent regional structural feature and is therefore somewhat unusual compared to other carbonatite and carbonatite-alkalic complexes of Ontario. Air photos of the area of the intrusion indicate that a number of linear features intersect at Seabrook Lake and that one north-trending linear is particularly well developed. Parsons (1961) mapped this lineament as a fault with offset, which implies that there has been some Late Precambrian adjustments in this area.

Mineralogic banding was noted in several places but measured attitudes have indicated no consistent pattern.

The extensive development of breccia and relatively broad area of fenitization suggest that the intrusion is exposed at a relatively high level.

PREVIOUS WORK

The complex was previously described by Parsons (1961) and Osatenko (1967). As part of Operation Chapleau, the writer briefly described the complex (Thurston *et al.* 1974).

RECOMMENDATIONS FOR THE PROSPECTOR

Phosphate and niobium values are known to exist within the complex (Parsons 1961). The phosphate values are erratic and generally not very high (files, International Minerals and Chemical Corporation (Canada) Limited).

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[1] Information from Assessment Files Research Office, Ontario Division of Mines, Toronto.

The joint Canpac Minerals Limited-Gunnex Limited program outlined three areas worthy of testing for niobium[1]. These zones are not likely to contain a large tonnage.

The best potential for the complex appears to be in delineating an area from which several mineral commodities could be produced; i.e. pyrochlore, apatite and vermiculite.

A hematite-rich carbonate sample from the complex returned 0.47 percent cerium oxide and 0.22 percent lanthanum oxide (Thurston *et al.* 1974) suggesting a possible potential as a source for rare earth elements.

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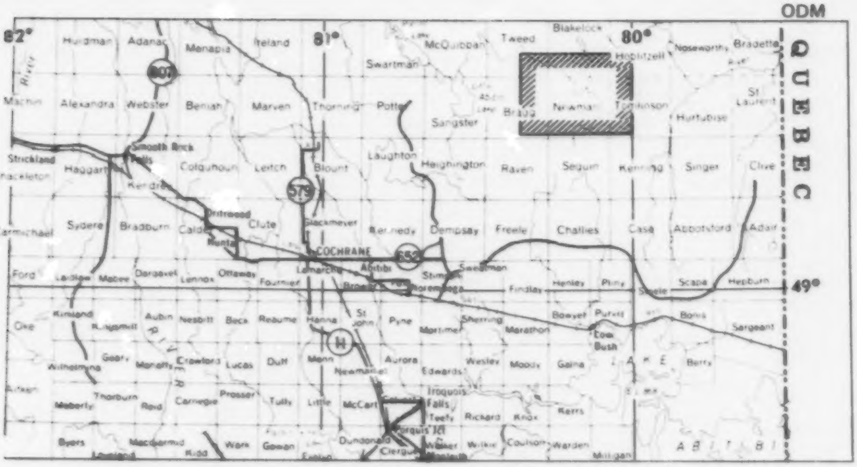
NO. 14 TWOPEAK LAKE AREA

DISTRICT OF COCHRANE

Bruce Wilson[1]



LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

LOCATION

The Twopeak Lake map-area, bounded by Longitudes 80°00′W and 80°22′30″W and by Latitudes 49°20′N and 49°30′N, lies about 131 km (82 miles) northeast of Timmins. Since no roads extend into this area, access to the numerous small lakes is restricted to helicopters and float-equipped aircraft. In Ontario, fixed-wing service is available in South Porcupine (near Timmins), in Cochrane 70 km (43 miles) southwest of Twopeak Lake, and in Kapuskasing 162 km (101 miles) west of Twopeak Lake. The area examined comprises 500 km^2 (193 square miles) and includes portions of Tweed, Blakelock, Hoblitzell, Bragg, Newman and Tomlinson Townships. The Ontario-Quebec border is 51 km (32 miles) east of Twopeak Lake.

MINERAL EXPLORATION

There has not been a great deal of exploration in the Twopeak Lake area. Thomson (1936) reported a small amount of prospecting previous to 1934, but the first claims were not recorded until 1940. A few claims were staked in 1956, and several larger pieces of ground were staked between 1966 and 1969, and from 1975 to the present.

Except for a large exposure of metavolcanics west of Twopeak Lake, outcrops are rare. As a consequence most exploration has been done by remote sensing (geophysical) methods. An airborne magnetometer survey, flown for Dome Exploration (Canada) Limited in 1975 covered the southern edges of Newman and Tomlinson Townships. More detailed ground surveys, both magnetic and electromagnetic, have been run for Conwest Exploration Company Limited in 1959, Cannon Mines Limited, Eagle Head Mines Limited, Kelly-K Mines Limited, Movado Mining Company Limited, Summit Explorations and Holdings Limited and Tripoint Mines Limited in 1967, Force Crag Mines Limited and Raejac

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Explorations Limited in 1968, and Noranda Exploration Company Limited in 1974.

Drill logs from follow-up diamond drilling have been submitted by Conwest Exploration Company Limited, Kelly-K Mines Limited, Nickel Rim Mines Limited, Raejac Explorations Limited, Summit Explorations and Holdings Limited, Texas Gulf Sulphur Company Incorporated and Tripoint Mines Limited. By far the most extensive program was that of Texas Gulf Sulphur Company Incorporated in the winter of 1967. A total of 2023 m (6,653 feet) was drilled in 18 holes.

Observations made during the summer of 1976 indicate a continuation of geophysical prospecting on several newly cut grids, and a probable continuation of drilling in the vicinity of Magiskan Lake.

GENERAL GEOLOGY

The Pleistocene cover of unconsolidated clays, sands and gravels is extensive and thick (overburden measures up to 57 m or 189 feet in drill logs) and bedrock outcrops are few and scattered. Bedrock within the map-area comprises metavolcanics, metasediments and granitic plutonic rocks of Early Precambrian age which are intruded by younger Early to Late Precambrian diabase dikes. The metamorphic grade west of Twopeak Lake appears to be amphibolite facies.

From the somewhat limited outcrop and drill data and the regional aeromagnetic maps (ODM-GSC 1964), the stratigraphic section in the supracrustal rocks is interpreted by the author to have at the base a unit of pyroclastic rocks covered by a series of mafic flows, a succession of mafic to intermediate pyroclastic rocks and finally a unit of metasediments. Each of the metavolcanic units includes minor amounts of thinly bedded metasediments. A general description of the rock types may be found in Bennett *et al.* (1967). The age relationship of the granitic rocks, metavolcanics and metasediments is uncertain. The granitic rocks intrude the metavolcanics west of Twopeak Lake and northwest of Magiskan Lake, however, the supracrustal rocks in general dip and face away from the granitic masses suggesting that the granitic rocks in part may represent a base upon which the supracrustal rocks were deposited. It is proposed that the Early Precambrian (Archean) centre of volcanism was to the east or northeast of the Twopeak Lake map-area.

Outcrops at the north end of Twopeak Lake which previously had been mapped as felsic to intermediate metavolcanics (Bennett *et al.* 1966) have been re-mapped as mafic flows continuous with the outcrops west of Twopeak Lake and with mafic outcrops 2.4 km (1.5 miles) southeast of Magiskan Lake. Outcrops of metasediments northwest of Twopeak Lake, northwest of Magiskan Lake, and at West Porphyry Lake have been re-mapped as the lower pyroclastic unit.

STRUCTURAL GEOLOGY

Detailed mapping of the flows west of Twopeak Lake has resulted in a new interpretation of the structure of the area. The mafic metavolcanics outcrop in a ϒ shaped configuration with the base pointing northeast across the north end of Twopeak Lake. The base comprises both branches of the ϒ opposed in an isoclinal syncline. The branches spread outward to the southwest until they trend northwest and southeast respectively, and face to the southwest. The overlying metasediments at the South Floodwood River face southwest and are not folded into the base of the ϒ. This pattern may be a consequence of the surfacing, between Twopeak Lake and the South Floodwood River, of the axis of a northeast plunging syncline (which forms the base of the ϒ). Southwest of the syncline the supracrustal rocks have been folded downward about a northwest trending hinge line.

The synclinal axis passes through the north ends of Twopeak, Springer and Little Porphyry Lakes, gradually turning to a more easterly trend near the eastern boundary of the map-area. The trends of the mafic flows can be traced as a series of magnetic depressions on the regional aeromagnetic maps (ODM-GSC 1964). The syncline is flanked on either side by anticlines, or more properly, elongate domes. The dome south of the syncline is cored by granite which outcrops in several locations. The smaller northern dome is probably also cored by granite, but none is exposed. Bedrock on the north limb of the northern dome (just northwest of Magiskan Lake) is isoclinally folded.

ECONOMIC GEOLOGY

Although several magnetic highs and electromagnetic conductors have been drilled, nothing of economic interest has been reported. Exploration has centred on the pyroclastics and metasediments which contain pyrite, pyrrhotite, magnetite and graphite. The metasediments include magnetite iron formation which accounts for the distinct magnetic high associated with this unit. A preliminary examination of diamond drill logs (Resident Geologist's files, Ontario Ministry of Natural Resources, Kirkland Lake) indicated that very minor amounts of chalcopyrite occur as veins or fine disseminations in the upper pyroclastic unit and metasediments. No chalcopyrite has been reported in the lower pyroclastic unit. Data from drilling and geophysical work suggest that the mineralization is stratigraphically conformable.

Assuming that the volcanic centre was east of the map-area, stratabound deposits of exhalitive origin are more likely to be found in that direction. The volume of felsic metavolcanics, rocks which are often associated with such ore deposits, appears to be low, however confirmation of rock compositions must await the results of chemical analysis. The best exploration targets may be the upper pyroclastic unit and metasediments, units which appear to continue to the Ontario-Quebec border (see Bennett *et al.* 1966).

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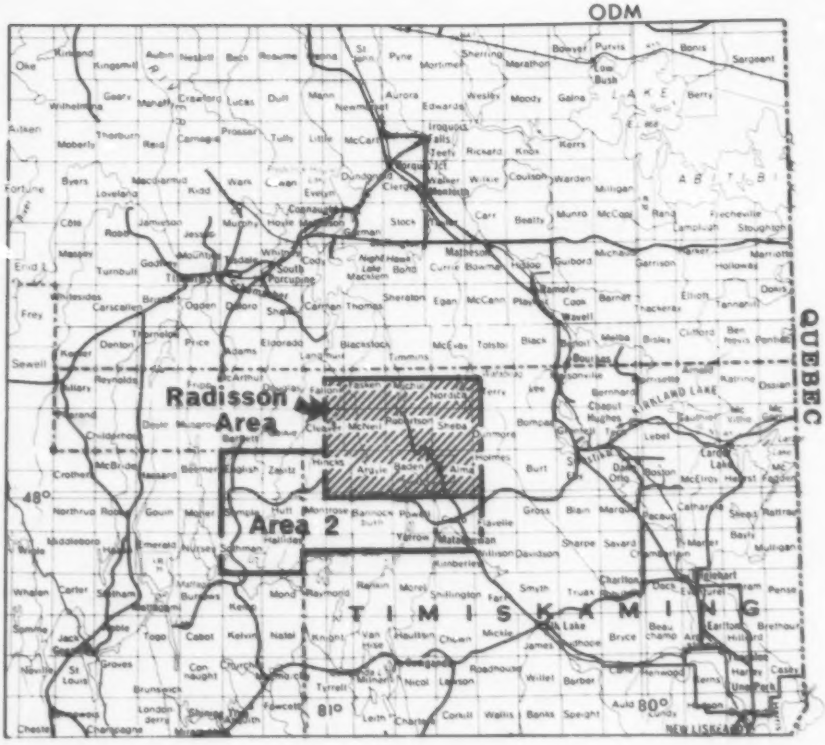
NO. 15 REGIONAL STRATIGRAPHY AND STRUCTURE OF THE TIMMINS AREA, DISTRICTS OF COCHRANE AND TIMISKAMING

and

NO. 15a RADISSON LAKE AREA, DISTRICT OF TIMISKAMING

D.R. Pyke[1]


ODM
QUEBEC
Radisson Area
Area 2
T I M I S K A M I N G
L A K E
A B I T I B I
Timmins
South Porcupine
Iroquois Falls
Matheson
KIRKLAND LAKE
NEW LISKEARD
48°
81°
80°

LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

INTRODUCTION

In 1976, the writer completed mapping of the Radisson Lake area. This was the final phase of a two year project which was being conducted concurrently with a project involving a regional stratigraphic synthesis of the Timmins-Kirkland Lake area (Pyke 1975a). Regional mapping was confined largely to Area 2 (outlined on location map), and is part of a continuing program involving the writer and L.S. Jensen, who is currently mapping in the Kirkland Lake-Larder Lake area (Jensen, *this volume*).

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[1] South Archean Subsection Leader, Precambrian Geology Section, Geological Branch, Ontario Division of Mines, Parliament Buildings, Toronto.

Field work for the Timmins-Kirkland Lake project is expected to continue for another two years. The emphasis is primarily on outlining the major rock stratigraphic units and regional structures. It is hoped that the integration of the known metals deposits into a regional stratigraphic framework will assist in delineating new areas of mineral potential as well as additional targets in known mineralized camps.

RADISSON LAKE AREA

LOCATION

The Radisson Lake area covers about 1000 km^2 (400 square miles) and is bounded by Longitudes 80°30′ to 81°00′W, and Latitudes 48°00′ to 48°15′N. The town of Matachewan is 6 km (4 miles) south of the area; Kirkland Lake is about 40 km (25 miles) west of the area.

ACCESSIBILITY

Access to much of the southern part of the area is good via Highway 566 which extends from Highway 66 to 27 km (17 miles) west of Matachewan. A number of logging roads extend north and west from Highway 566 into the southern part of the area. Access to the northern part of the area is more difficult, particularly in McNeil, Robertson, and parts of Fallon, Cleaver and Fasken Townships, where access by helicopter or float-equipped aircraft is desirable.

MINERAL EXPLORATION

With the discovery of gold in Timmins in 1908, the waterways of the Radisson Lake area (primarily the Montreal and Whitefish Rivers), provided the most convenient canoe route between Elk Lake, Matachewan and Timmins. As a result many prospectors flooded the area, but most of the exploration was confined to the more accessible southern and eastern parts of the area. Gold was discovered at two properties in the southern part of Powell Township, near the town of Matachewan in 1916. These discoveries subsequently led to the incorporation of Young-Davidson Mines Limited and Matachewan Gold Mines Limited, both of which began production in 1934, and ceased operations in the mid 1950s.

In 1930, gold was discovered in the northwest part of Bannockburn Township (SW part of Radisson Lake area). Production began from Ashley Gold Mining Corporation Limited in 1932 and when operations ceased in 1934, approximately 150,000 tons of ore had been milled. Although numerous other gold showings have been found in the Radisson Lake area, none have proven to be economic. Two properties of particular interest, which have received extensive exploration are the former French property (Dyer 1935) in west-central Baden Township, and the Thesaurus property (Dyer 1935; Lovell 1967) near the north boundary of Baden Township.

More recently, a few ground and airborne geophysical surveys have been conducted in the Radisson Lake area by a number of companies. Minor follow-up diamond drilling failed to disclose mineralization of economic importance.

In 1974, the Ontario Division of Mines contracted Questor Surveys Limited to conduct airborne electromagnetic (INPUT) and magnetic surveys of a large part of the Radisson Lake area (ODM 1975); the results of the survey, released in the spring of 1975, led to a minor staking rush.

During the summer of 1976, Manitou Lake Gold Mines Incorporated, Noranda Mines Limited, Texasgulf Incorporated and Utah Mines Limited were actively engaged in exploration in the immediate area.

GENERAL GEOLOGY

Bedrock in the area consists of Early Precambrian (Archean) metavolcanic and plutonic rocks. Extensive drift mantles much of the northern part of the area.

The oldest rocks in the area are largely composed of calc-alkaline andesite-dacite and minor rhyolite, exposed in parts of Fallon and Fasken Townships in the northwest part of the Radisson Lake area. These rocks formerly interpreted to occupy a synclinal structure (Pyke 1973; Pyke *et al.* 1973) probably lie within a local anticlinal structure confined to the west side of the stock of granodiorite extending into Fasken Township. Overlying these calc-alkaline volcanic rocks is a sequence composed dominantly of iron-rich tholeiitic basalts which extend across the southern and central portions of the map area; maximum thickness of this tholeiitic sequence is approximately 3000 m (10,000 feet). Minor ultramafic pyroclastic rocks and flows and associated komatiitic basalts occur toward the bottom of the tholeiitic sequence, and are best exposed in the Matachewan area to the south. An overlying pyroclastic unit composed almost entirely of massive andesitic-dacitic crystal tuff and tuff-breccia has a maximum thickness of approximately 3600 m (12,000 feet), and extends from the eastern half of Hincks Township to the eastern boundary of Alma Township. Crystal fragments within this tuff-breccia unit are composed almost exclusively of subhedral grains of plagioclase and lesser amphibole; lithic fragments are dominantly composed of crystal tuff with a somewhat different crystal to matrix ratio than the enclosing tuffaceous matrix. Breccia sized fragments up to 200 cm (6 feet) in maximum dimension were observed locally, but most are in the order of 10 to 20 cm (4 to 8 inches). The crystal and lithic fragments are set in a fine-grained, light to medium green matrix of dominantly calc-alkaline dacite to andesite composition (Pyke, *unpubl. analyses*). Minor porphyritic pillowed flows of calc-alkaline andesite are interlayered with the tuff-breccia unit.

Stratigraphically, the tuff-breccia unit is tentatively correlated with the Blake River Group, the tholeiitic sequence with the Kenojevis Group, and the basaltic komatiites and ultramafic metavolcanics with the basal part of the Tisdale Group (Pyke 1975b) and perhaps the Stoughton-Marriott Group (Jensen 1976).

Small plugs and sills of gabbro and ultramafic intrusions are locally common and found mainly toward the top of the tholeiitic sequence.

The southern portion of a large stock of granodiorite (Pyke *et al.* 1973), and the southern extension of the Watabeag Lake Batholith (Pyke 1976) underlies much of the northwest part of the area. Part of the Cairo Stock of hornblende syenite (Lovell 1967) underlies the southeast part of the area.

North-trending diabase dikes, forming part of the Matachewan dike swarm (Fahrig *et al.* 1965) intrude all the Early Precambrian rocks in the area.

Relatively flat lying Middle Precambrian sedimentary rocks of the Cobalt Group outcrop in the southwest part of the area and unconformably overlie the Early Precambrian rocks.

STRUCTURAL GEOLOGY

The major structure is an eastward plunging syncline, the axial trace of which extends east-west across the south-central part of the map-area. The tuff-breccia unit discussed in the section on general geology occupies the central portion of this syncline.

The northwest-trending Montreal River and Cross Lake faults (Pyke *et al.* 1973) traverse the area; minor subparallel faults are common. Numerous north-trending lineaments, some of which delineate faults, are common.

ECONOMIC GEOLOGY

Gold

With the exception of the Ashley mine, none of the numerous gold showings in the area have proven to be economic. Virtually all the known gold mineralization is associated with quartz veining which occurs in a variety of host rocks of which basalt and syenite are the most common. In addition, minor gold occurrences are related to iron formation, and others to veins of quartz feldspar porphyry (Rickaby 1932) and syenite (Dyer 1935).

A large number of showings, especially in the area near Matachewan, received considerable exploration work during the 1930s.

At the Ashley mine, gold was mainly confined to two large quartz veins. The host rocks for the veins are largely pillowed and massive basalts (Rickaby 1932). Abundant fine-grained serpentinite is present on the mine dumps, and undoubtedly formed part of the nearby wall rock.

Copper and Molybdenum

Minor chalcopyrite and molybdenite occur in a number of quartz veins associated with small plugs of syenite and diorite in Baden and Powell Townships (Lovell 1967).

AIRBORNE ELECTROMAGNETIC SURVEY

The airborne electromagnetic (INPUT) survey, flown for the Ontario Division of Mines, outlined a number of anomalies; however, most of these are located immediately south of the map-area. In general, many of the INPUT anomalies appear to be located along a broad contact zone near the base of the tholeiitic sequence, involving komatiitic and calc-alkaline metavolcanics, clastic metasediments and iron formation. This contact zone would correspond to the interface between the two supergroups proposed by Pyke and Jensen (1976) for the Timmins-Kirkland Lake area.

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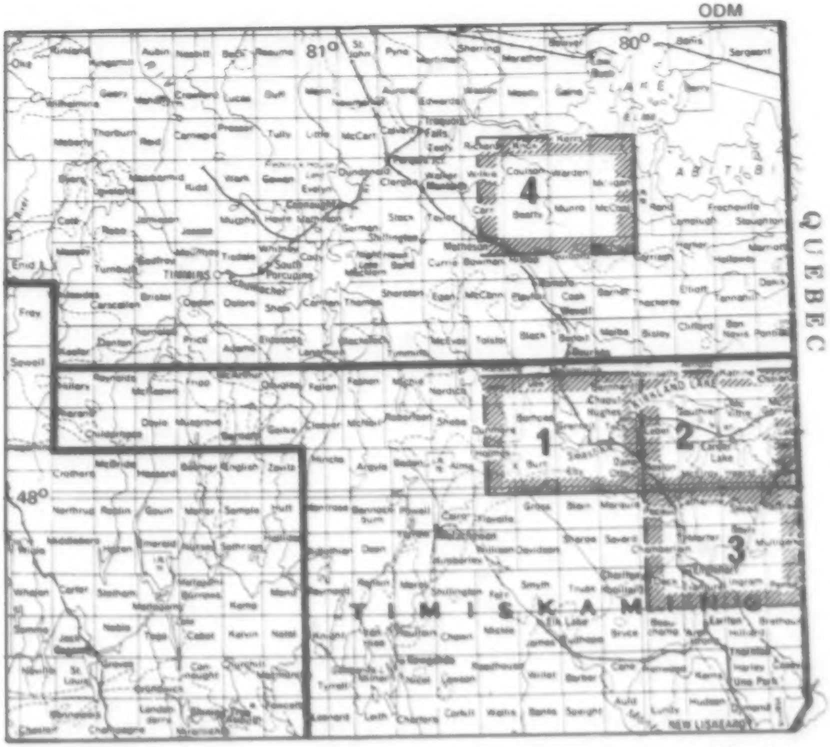
NO. 16 REGIONAL STRATIGRAPHY AND STRUCTURE OF THE TIMMINS-KIRKLAND LAKE AREA DISTRICT OF COCHRANE AND TIMISKAMING

and

NO. 16a KIRKLAND LAKE AREA, DISTRICT OF TIMISKAMING

L.S. Jensen[1]


ODM
81°
80°
48°
QUEBEC
T I M I S K A M I N G
TIMMINS
KIRKLAND LAKE
NEW LISKEARD
LAKE ABITIBI
1
2
3
4

LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

INTRODUCTION

In 1975, field work was begun on a stratigraphic synthesis of the Timmins-Kirkland Lake sheet by D.R. Pyke and the writer (Pyke 1975a). Mapping by the writer was confined to the eastern part of the sheet shown on the location map: Area 1, the Kirkland Lake map-area represents the first part of a two year mapping program at a scale of 1 inch to 1 mile (1:63,360), which is being conducted concurrently with the more regional mapping of the Timmins-Kirkland Lake Sheet. Areas 2, 3, and 4 represent areas of potential future programs which are now being partially investigated to determine the regional stratigraphy and structure of the Timmins-Kirkland Lake area. Previous mapping by the author includes the Ramore area (Jensen 1974, 1975c), the Lightning River area (Jensen 1972, 1973) and townships within the Magusi River area (Jensen 1975a; 1975b; 1976a).

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The regional mapping of the Timmins-Kirkland Lake sheet is a joint project involving D.R. Pyke, who is currently mapping in the western half of the sheet (Pyke *this volume*), and the writer. Field work for the Timmins-Kirkland Lake Project is continuing with emphasis primarily on outlining major rock stratigraphic units and regional structures. The integration of known metal deposits into a regional stratigraphic framework will assist in delineating new areas of mineral potential as well as additional targets in areas of known mineralization.

LOCATION AND ACCESS

The writer's main responsibility in the regional stratigraphic and structural program for the Timmins-Kirkland Lake area includes the area between Longitude 80°30′W and the Quebec-Ontario boundary. The area is well served by Highways 11, 66, 101, 112, and 624 and the many logging, concession and recreation roads that extend from these highways. Map-areas where active field mapping is being carried out within the larger area, are as follows:

Area 1, Kirkland Lake map-area -
Latitudes 48°00′ to 48°15′N
Longitudes 80°00′ to 80°30′W
Area 2, Larder Lake map-area -
Latitudes 48°00′ to 48°15′N
Longitudes 79°30′ to 80°00′W
Area 3, Englehart map-area -
Latitudes 47°45′ to 48°00′N
Longitudes 79°30′ to 80°00′W
Area 4, Matheson map-area -
Latitudes 48°30′ to 48°45′N
Longitudes 80°00′ to 80°30′W

Each map-area encompasses an area of approximately 1000 km^2 (400 square miles).

MINERAL EXPLORATION

Gold was initially discovered in the vicinity of Larder Lake in 1906 (Thomson 1941, p.40). Shortly, thereafter, several gold mines were brought into production near Kirkland Lake, 24 km (15 miles) west of Larder Lake and numerous additional mines were brought into production during the period from 1920 to 1940. Much of this early exploration activity is described in geological reports on the area by the Ontario Department of Mines.

Between 1950 and 1975, the emphasis has been on the search for base metals, iron and asbestos. Recent fluctuations in the value of gold and silver have spurred new interest in exploring the area for precious metals. For recent mineral exploration in the Kirkland Lake area see report by H.L. Lovell *et al.* (1976) *in* Annual Report of Regional and Resident Geologists.

GENERAL GEOLOGY

Bedrock in the area consists of Early Precambrian (Archean) metavolcanic, metasedimentary and plutonic rocks. Middle Precambrian (Huronian) sedimentary rocks unconformably overlie the Early Precambrian rocks in parts of the area. Pleistocene deposits of till, esker deltaic sand and varved clay overlie the bedrock throughout the area.

Kirkland Lake Map-Area

The major geological features of the Kirkland Lake map-area are shown on Map 2205 (Pyke, Ayres and Innes 1973). The north part of the map-area in Maisonville, Grenfell, Bernhardt and north part of Teck Townships is underlain by metavolcanic and associated intrusive rocks composed of gabbro and diorite. Granitic rocks associated with the Winnie Lake Stock also occur in this area. These rocks are separated from a large second area of volcanic rock to the south in Eby and Otto Townships by a narrow zone of sedimentary rock referred to as Timiskaming metasediments. Granitic rocks belonging to the Round Lake Batholith and the Otto Syenite Stock intude the volcanic rocks in Eby and Otto Townships as do several other smaller bodies of gabbro, diorite and syenite. In the west part of the Kirkland Lake map-area, the metavolcanics and Timiskaming metasediments are extensively intruded by the Watabeag Batholith and the Holmes Syenite Stock and all are overlain unconformably by Middle Precambrian (Huronian) sedimentary rocks.

Work during the 1976 field season revealed that the metavolcanics in Maisonville, Grenfell and much of Bernhardt Township, and in the north part of Teck Township are part of a thick tholeiitic sequence that occupies the outer parts of a large synclinorium to the north (Jensen 1975a). This thick tholeiitic sequence has been traced north and then east around the nose of the synclinorium to the Quebec-Ontario boundary where it can be correlated with the Kinojevis Group (Jensen 1976a, 1976b). The tholeiitic sequence consists of magnesium-rich (6 to 10 percent MgO, and 9 to 12 percent FeO approx.) basaltic flows alternating with iron-rich (3 to 6 percent MgO, and 12 to 18 percent FeO, approx.) basalt (Jensen 1976b). This zone of tholeiitic lavas also extends east into the Larder Lake map-area where it occurs in the south parts of Morrisette, Katrine and Ossion Townships (Jensen 1975b) and in the north parts of Lebel, Gauthier, McVittie and McGarry Townships.

Calc-alkaline metavolcanics occur in the northeast part of Bernhardt Township. These rocks are mainly high aluminum basalts and andesites belonging to the Blake River Group previously described farther to the north by Jensen (1975a; 1976a).

The tholeiitic rocks of the Kinojevis Group also extend farther west around the Watabeag Batholith (Pyke 1976). Tholeiitic volcanic rocks which occur in the north part of Holmes Township are also believed to be part of the Kinojevis Group. Here, the magnesium-rich and iron-rich tholeiitic basalts are metamorphosed to upper greenschist facies and amphibolite facies grade by the Watabeag Batholith and the Holmes Syenite Stock.

The metavolcanics in Eby and Otto Townships occur in a syncline south of the Timiskaming metasediments (Lovell 1972). These rocks form part of a komatiitic volcanic sequence that extends west under the Huronian sedimentary rocks into the south part of Holmes Township and east into the Larder Lake map-area as far as Hearst and McGarry Townships. This komatiitic sequence is composed of several lithostratigraphic units of ultramafic and basaltic komatiite and magnesium-rich tholeiite (see Jensen 1976b for rock classification). Polysuturing and spinifex textures (Pyke, Naldrett and Eckstrand 1973) occur in many of flows within the ultramafic and basaltic komatiitic stratigraphic units and along with pillow structures found in flows within the magnesium-rich tholeiitic stratigraphic units can be used to determine top relationships. The author determined regional strikes by tracing out separate units of ultramafic komatiite, basaltic komatiite and magnesium-rich tholeiite.

Toward the base of the komatiitic sequence along the north limb of the syncline, a major fault occurs at the contact between the Timiskaming metasediments and the komatiitic sequence. This fault is partly indicated by Thomson (1948b) and Lovell (1972). Several lithostratigraphic units of ultramafic komatiite, basaltic komatiite and magnesium-rich tholeiitic basalt are obliquely truncated at an angle of 25 degrees or less by the fault.

On the south limb of the syncline, the komatiitic sequence is interlayered with cherty tuff and minor iron formation. This zone of cherty tuff and iron formation has been traced from Eby Township through Otto Township into Boston Township by Lovell (1972). South of the cherty tuff zone, the komatiitic metavolcanics are amphibolitized and truncated by the Otto Syenite Stock and the Round Lake Batholith.

The metavolcanics in the south part of Burt Township and north parts of Flavelle and Gross Townships are part of a tholeiitic sequence and represent a group of volcanic rocks distinct from the komatiitic sequence to the east in Eby Township. Iron formation occurs interlayered with the tholeiitic lava flows in Burt Township. However, because these iron formations occur in volcanic rocks chemically distinct from those found with iron formation in Eby Township, no correlation can be made between the two areas of iron formation as proposed by Ridler (1976a).

The Timiskaming metasediments extend from Kenogami Lake (Eby Township) through to Teck Township and further east. They form a narrow, continuous belt from 0.8 to 5 km (0.5 to 3 miles) wide. They consist of a south-facing monoclinal sequence of argillite, greywacke and conglomerate interlayered with flows, tuffs and tuff-breccia of trachyte composition. Toward the top of the sequence the Timiskaming metasediments are truncated by faulting. Previous work by Richard Hyde, McMaster University (personal communication) indicated that the Timiskaming sedimentary rocks from Kenogami Lake to Kirkland Lake are fluviatile sediments deposited in river channels flowing east. Field work by the author concentrated on distinguishing stratigraphic units within the Timiskaming metasediments and metavolcanics. At present, three distinct sedimentary lithologies can be distinguished and traced several miles. They consist of conglomerates, greywackes and argillites derived mainly from a komatiitic volcanic source; conglomerates, greywackes and argillites derived from a carbonate-rich environment (see Economic Geology), and conglomerates, greywackes and argillites derived principally from trachytic volcanic rocks interlayered with the sedimentary rocks. The trachytic volcanic rocks are mainly trachyte tuff-breccias and finely bedded, waterlain crystal tuffs. Conglomerates, greywackes and argillites with volcanic debris derived from the volcanic sequences of tholeiitic and calc alkaline composition to the north have not yet been recognized. However, many of the lower stratigraphic units, particularly the basal conglomerates in the Timiskaming have not been studied nor has the unconformity (Thomson 1948a) between the underlying tholeiitic rocks and Timiskaming metasediments been re-examined by the author. It is expected that some of the lower conglomerates, greywackes and argillites will show that some material was derived from volcanic terrain to the north in the form of iron-rich tholeiitic basalt and calc alkaline basalt, and andesite pebbles and grit.

Strike faults, cross-faults, and oblique faults occur in the Timiskaming metasediments and metavolcanics. Portions of the komatiitic sequence to the south have been faulted in with the Timiskaming rocks in several places. Narrow slices of the komatiitic sequence occur within the Timiskaming sequence in Eby, Grenfell, and Teck Townships in the Kirkland Lake map-area and also in the Larder Lake map-area in Lebel, Gauthier, McVittie, McGarry, McEroy, and Hearst Townships. The proposal that the volcanic rocks to the south (Highway 11 basalts of Ridler 1970, 1975, 1976a, 1976b) rest conformably on top of the Timiskaming sequence and are younger, is difficult to accept in light of these new observations.

The author considers the main source of the clastic material comprising the upper part of the Timiskaming sedimentary sequence to be the komatiitic sequence to the south and the slices of this komatiitic sequence faulted in with the Timiskaming sequence. The 'komatiitic' conglomerates have ultramafic komatiite pebbles, basaltic komatiite pebbles and magnesium-rich tholeiitic pebbles as well as pebbles of iron formation, chert, trachyte and a variety of feldspar porphyries enclosed in a matrix rich in chlorite, serpentine and talc. The 'carbonate' conglomerates (see Economic Geology) have grey, green and buff 'carbonate' pebbles along with a few noncarbonatized ultramafic pebbles set in a detrital carbonate-rich matrix. The carbonate conglomerates also have pebbles of iron formation, trachyte and feldspar porphyry. Because neither ultramafic flows nor carbonatized ultramafic komatiites are present in the tholeiitic sequence to the north in the adjoining volcanic terrain, the material was probably derived from similar rocks found in the komatiitic sequence to the south i.e. the Highway 11 basalts of Ridler (1976a).

As previously mentioned, the upper contact of the Timiskaming sequence is a fault contact. This fault contact truncates several of the upper stratigraphic units in the Timiskaming sequence and several of the syenitic bodies which intrude both the Timiskaming metasediments and the volcanic rocks to the south. This is clearly exposed in several outcrops where the Timiskaming metasediments are in contact with the volcanic rocks to the south. Displacement along the contact is yet unknown, but must be in the order of several hundred metres.

A wide variety of intrusive rocks occur in the Kirkland Lake area. Several small circular bodies of intrusive peridotite were located in the komatiitic sequence of Eby, Otto and Teck Townships. In addition, more complex sill-like bodies containing peridotite, pyroxenite, and gabbro were studied in this area. Gabbroic rocks in Teck, Grenfell, and Maisonville Townships are mainly thick massive flows similar to those observed farther to the north in Black, Cook, Playfair, Barnet, and Thackeray and several other townships by the author. Some of the gabbroic rocks may possibly be intrusive feeders to the surrounding tholeiitic volcanic rocks.

The large sill-like gabbroic body in the south part of Burt Township (Moore 1966) contains magnetite and sulphide rich layers 5 to 8 cm thick alternating with layers rich in gabbroic silicate minerals 5 to 13 cm thick.

The Round Lake Batholith is a multiple intrusive body containing several phases of trondhjemite. Sufficient work was not done to distinguish the relative ages of the intrusive phases. Much of the growth of the batholith took place by the gradual assimilation of the older surrounding volcanic rocks (see Larder Lake map-area) as well as by displacement of the volcanic rocks.

The Watabeag Batholith is poorly exposed. Exposures reveal that the Watabeag Batholith is mainly composed of hornblende granodiorite (Pyke 1976).

The syenitic rocks are a complex group of intrusive rocks which range from small dikes a few metres long and less than 10 cm wide to stocks as large as the Otto Syenite Stock which is more than 10 km (6 miles) in diameter. The syenitic rocks range from Na-rich syenodiorites to K-rich syenites and they range from extremely mafic olivine-rich to felsic feldspar-rich rocks. The mafic syenites appear to be hybrid phases developed by the more felsic syenites while intruding the ultramafic komatiites.

A few north-trending Matachewan diabase dikes cut all the previously described rocks.

The Middle Precambrian, Huronian sedimentary rocks are mainly relatively flat lying quartzite, greywacke, and conglomerate of the Cobalt Group, found in Burt and Holmes Townships where they have been previously described by Moore (1966).

Larder Lake Map-Area

Many of the features described in the Kirkland Lake map-area extend east into Larder Lake map-area. These include the extension of the Kinojevis tholeiitic metabasalts and Blake River calc-alkaline metabasalts into the north part of the area, north of the Timiskaming metasediments and metavolcanics. The komatiitic sequence in Eby and Otto Townships also extends east through Boston, Gauthier, McElroy, Hearst and northern Skead Townships. The faulted northern contact of the komatiitic volcanic rocks against the Timiskaming rocks continues to the north with some wedges of the komatiitic rocks incorporated in the Timiskaming in Lebel, Gauthier, McVittie and McGarry Townships. Similarly the Timiskaming metasediments in this area are divisible into 'trachytic', 'komatiitic' and 'carbonate' conglomerates, greywackes and argillites and volcanic rocks composed of trachyte in the form of flows, tuff-breccias and crystal tuffs.

Further work will be necessary to determine the true stratigraphic relationships of the 'Timiskaming' metasediments in McElroy and Hearst Townships which appear to be infaulted blocks within the komatiitic sequence. However, the numerous bodies of peridotite gabbro and syenitic rocks obscure the relationships.

Detailed work reveals that the iron formation in Boston Township is associated with calc-alkaline felsic tuffs and tuff-breccias and interlayered with ultramafic and basaltic komatiite with polysuturing and spinifex textures. The tuff-breccias are similar in appearance to the tuff-breccias that extend into Skead Township and probably represent a distal facies of the upper portion of calc-alkaline volcanism in Skead Township where a volcanic vent was reported by Hewitt (1949) (see Englehart Map-Area). Stratigraphically below the calc-alkaline volcanic rocks and the iron formation is a sequence of tholeiitic volcanic rocks. These tholeiitic rocks are truncated by the Otto Syenite Stock to the west but continue to the southeast into Catherine Township where they have been named the Catherine basalts (Ridler 1970). These basalts consist of alternating units of magnesium-rich and iron-rich tholeiitic basalts.

Stratigraphically below the tholeiitic sequence is an older komatiitic sequence near Boston Creek. These rocks can be divided into ultramafic komatiite, basaltic komatiite and magnesium-rich tholeiitic basalt units which can be traced through a thick shear zone near the margin of the Round Lake Batholith, to their contact with the Round Lake Batholith. Several of these units are truncated by the Round Lake Batholith as are some interflow cherts and iron formations in the komatiitic sequence.

Englehart Map-Area

Only a few traverses were made into the Englehart map-area in order to extend the stratigraphy found in the Larder Lake map-area. A monoclinal sequence of metavolcanics occurs east of the Round Lake Batholith (Ridler 1970). At the base of the sequence is a 6000 to 7500 m (20,000 to 25,000 feet) thick suite of alternating magnesium-rich and iron-rich tholeiitic basalts. Above these tholeiites is a complex series of predominantly calc-alkaline basaltic andesite comprising fragmental tuffs, tuff-breccias and agglomerates (Hewitt 1949). A few dacites and rhyolites occur as crystal tuffs in the calc-alkaline sequence. Feldspar porphyry fragments occur in many of the fragmental rocks particularly toward top of the sequence.

Unconformably overlying the calc-alkaline volcanic rocks in the northwest part of Skead Township is a sequence of ultramafic and basaltic komatiite. This zone represents the base of the komatiitic sequence that extends west into the Larder Lake and Kirkland Lake map-areas. Sill-like bodies of peridotite and thin zones of interflow rhyolite tuff occur toward the base of the komatiitic sequence. These tuffs appear to be on the same stratigraphic level as the tuffs containing iron formation in Boston Township and seem to mark a transition from calc-alkaline volcanism to komatiitic volcanism.

Matheson Map-Area

Only a few traverses were completed in order to obtain a continuous cross section of the volcanic rocks in the area. Ultramafic komatiite, basaltic komatiite and magnesium-rich tholeiite were recognized in the south parts of Munro and Beatty Townships as were some carbonatized ultramafic komatiites. Work will continue next field season to obtain a complete cross-section in McCool, Munro, Beatty, Warden and Coulson Townships to extend the volcanic stratigraphy west from the Lightning River area (Jensen 1973).

ECONOMIC GEOLOGY

Gold and Silver

Except in the "Main Ore Zone" at Kirkland Lake (Thomson *et al.* 1948) most of the gold mineralization was described as being closely associated with quartz veins cutting carbonatized volcanic rocks (Thomson 1941; Thomson and Griffis 1941; Thomson 1948b). Much of this rock is described as "green carbonate" or "dolomite". The Main Ore Zone at Kirkland Lake was ascribed to the late introduction of gold-bearing quartz veins along fractures in the syenites and metasediments (Thomson *et al.* 1948, p.102). Except for the Kerr Addison gold mine at Virginiatown, the most successful mines, namely the Toburn, Wright-Hargreaves, Teck-Hughes, Lake Shore, Sylvanite and Macassa mines, were located in the Main Ore Zone at Kirkland Lake. Green carbonate, although present in small amounts in some ore bearing zones within the Main Ore Zone at Kirkland Lake, was not a major factor in the search for gold-bearing quartz veins.

Recently Ridler (1970; 1976a; 1976b), recognizing the association of gold mineralization and green carbonate, has attempted to relate the deposition of carbonates, sulphides, and iron formation to sedimentary facies associated with volcanic exhalitive processes in the Kirkland Lake-Noranda area. He correlated the iron formation in Boston Township with the carbonate rocks found in the Timiskaming metasediments and nearby metavolcanics and with the base metal sulphide deposit at the Horne Mine in Noranda. An important corollary to this hypothesis is that the komatiitic sequence in Eby and Otto Township (Highway 11 basalts, Ridler 1970) are younger and conformably overlie the Timiskaming metasediments (Ridler 1970) (see "Kirkland Lake Map-Area" of this report).

First, it must be recognized that two major types of carbonate occur in the Kirkland Lake-Larder Lake area; a sedimentary carbonate and a volcanic carbonate. The main carbonate (green carbonate) is associated with alteration in the ultramafic and basaltic komatiitic flows. It was observed by Pyke (1974) that many of the green carbonates are the result of alteration of ultramafic and basaltic komatiite in the Timmins area. In the Larder Lake area a similar close spatial relationship occurs between green carbonate and ultramafic and basaltic rocks at the Kerr Addison gold mine in Virginiatown and other locations in McGarry, McVittie and Gauthier Townships (Jensen 1974). Many of these green carbonates have relict polysuturing and spinifex textures as they do in Hislop, Guibord and Michaud Townships near the Destor-Porcupine Fault (Jensen 1974). During this past field season, this same relationship was observed in Eby, Otto, Teck, Lebel, Hearst and Skead Townships in the areas of carbonatized komatiitic volcanic rocks south of the Timiskaming metasediments (i.e. McVittie basalts and Highway 11 basalts of Ridler 1970) and in the fault bounded slices of these rock found in the Timiskaming sequence. However, only a small percentage of the ultramafic and basaltic komatiites were transformed into green carbonate and of these only a few appear to be favourable for gold and silver mineralization (G. Hinse, Kerr Addison Mines Limited, personal communication).

The carbonate appears to form in elongated zones in certain ultramafic and basaltic komatiitic flows, or parts of certain ultramafic and basaltic komatiitic flows, usually parallel to subparallel with the strike of the flow, at several different stratigraphic levels within the komatiitic sequence. A complete gradation from 'unaltered' komatiite to deep green, chrome mica-rich, massive carbonate can be observed in several outcrops and in drill cores collected for study by the writer.

The process by which ultramafic and basaltic komatiite are altered to carbonate is not certain. It could be an autometamorphic phenomenon or an interaction of sea water with the ultramafic komatiite and basaltic komatiite. In most cases, however, the green carbonates are located near areas of syenite intrusion or faulting or both. This would explain why the green carbonate occurs mainly along major fault zones such as the Destor-Porcupine Fault and the Kirkland and Larder Lakes Fault zones where numerous felsic intrusions also occur.

The development of quartz veins in the carbonates appears to be related to the degree to which the komatiitic volcanic rocks are carbonatized. The addition of CO_2 and possibly lesser amounts of potash to the ultramafic komatiites would serve to explain the formation of carbonate, chrome and vanadium mica, phlogopite, sericite and the attendant quartz veining. In many places, the ultramafic and basaltic komatiites are altered to talc and talc-chlorite schists instead of carbonate in and near zones of faulting and syenite intrusion. A lack of necessary CO_2 may be responsible. In many places a gradation occurs between quartz-poor talc schist to quartz-rich green carbonate.

The second group of carbonates, the sedimentary carbonates are detrital Timiskaming metasediments. They range from finely bedded, fine-grained 'carbonates' to coarsely bedded conglomeratic 'carbonates'. They are interlayered with other Timiskaming sedimentary rocks and should not be correlated with the carbonates developed in the older komatiitic sequence to the south (see Ridler 1976a, 1976b). The presence of green carbonate and other carbonate material as silt-size to pebble-size fragments, along with noncarbonatized, spinifex-textured ultramafic komatiite, basaltic komatiite and magnesium-rich tholeiite fragments of similar size within the 'carbonate' sedimentary rocks indicate that these sedimentary carbonates were derived from an older komatiitic volcanic terrain in which carbonatization had occurred prior to their erosion.

The source of gold and the process by which gold is concentrated in certain green carbonates such as those at the Kerr Addison gold mines is not certain. The gold may have been leached from the surrounding host rocks by a process similar to that envisaged by Pyke (1975b) or may have been brought in from a deeper seated source along with the CO_2 during carbonatization of the ultramafic and basaltic komatiites.

The Timiskaming metasediments that are rich in sedimentary carbonate may be favourable zones of placer gold, provided they were derived from carbonatized ultramafic and basaltic komatiite with anomalous concentrations of gold.

Gold in the Main Ore Zone at Kirkland Lake appears to have formed by a late deposition of gold-bearing quartz veins (Thomson 1948a, p.105). Source of the gold and quartz could have been a remobilization of gold and quartz at depth in earlier formed green carbonate.

Iron

Iron formation of sufficient grade and quantity occurs near surface in Boston Township such that iron can be mined from a series of small open pits.

Nickel, Asbestos, Talc and Magnesite

Favourable zones for nickel, asbestos, talc and magnesite may be present in the komatiitic sequences that occur in Eby, Otto, Boston, McElroy, Gauthier, Hearst and Skead Townships. Several bodies of peridotite, and pyroxenite are also present within the sequences.

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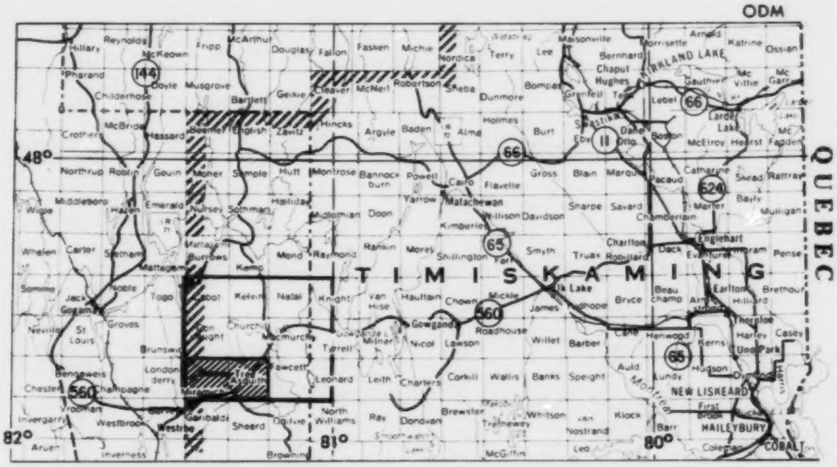
NO. 17 THE SHINING TREE AREA

DISTRICTS OF TIMISKAMING AND SUDBURY

M.W. Carter[1]


ODM
QUEBEC
TIMISKAMING
48°
82°
81°
80°
144
66
11
624
65
560
NEW LISKEARD
HAILEYBURY
COBALT
Reynolds
Hillary
McKeown
Fripp
McArthur
Douglas
Fallon
Fasken
Michie
Nordica
Terry
Lee
Maisonville
Bernhardt
Chaput Hughes
Larder Lake
Gauthier
Pharand
Doyle
Musgrove
Bartlett
Geikie
Cleaver
McNeil
Robertson
Sheba
Dunmore
Bompas
Childerhose
McBride
Crothers
Hassard
Beemer
English
Zavitz
Hincks
Argyle
Baden
Alma
Holmes
Burt
Northrup
Robb
Gouin
Moher
Semple
Hutt
Montrose
Bannockburn
Powell
Cairo
Flavelle
Gross
Blain
Marquis
Catharine
Skead
Rattray
Middleboro
Emerald
Halliday
Midlothian
Doon
Yarrow
Matachewan
Willison
Davidson
Sharpe
Savard
Chamberlain
Mulligan
Whelan
Carter
Mattagami
Burrows
Kemp
Mond
Raymond
Rankin
Morel
Kimberley
Shillington
Smyth
Truax
Robillard
Charlton
Dack
Englehart
Evanturel
Ingram
Pense
Knight
Van Hise
Haultain
Chown
Mickle
James
Bryce
Beauchamp
Earlton
Brethour
Hilliard
Neville
St. Louis
Groves
Cabot
Kelvin
Natal
Churchill
Connaught
Macmurchy
Tyrrell
Gowganda
Nicol
Lawson
Roadhouse
Willet
Barber
Henwood
Kerns
Harley
Casey
Chester
Champagne
London
Fawcett
Leonard
Leith
Charters
Cornill
Wallis
Banks
Speight
Auld
Lundy
Hudson
Dymond
Invergarry
Vrooman
Westbrook
Garibaldi
Sheard
North Williams
Ray
Donovan
Brewster
Whitson
Klock
Firstbrook
Tretheway
Nostrand
Barr
Aruen
Inverness
Browning
McGiffin
Leo
Coleman

LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

INTRODUCTION

During the summer of 1976 the writer carried out mapping at a field scale of 1 inch to ¼ mile (1:15,640) in Asquith and Miramichi Townships and in a strip of country lying between the western boundaries of the Townships of Cabot, Connaught and Miramichi and the meridian of 81°30′W Longitude. The purpose of the work was to complete the mapping of the Shining Tree map-area to provide material for a regional stratigraphic and structural synthesis.

LOCATION

The Shining Tree area is bounded by Latitudes 47°30′ and 47°45′N and Longitudes 81°00′ and 81°30′W, and is traversed by Highway 560 which crosses it diagonally from northeast to southwest.

Highway 560, an all-weather gravel road, crosses Asquith Township diagonally and passes close to the south of Miramichi Township. Access is good for Asquith Township, except for the southeastern corner, and moderately good for Miramichi Township. A road serving the Hydro-Electric Power Commission of Ontario transmission line in western Miramichi Township makes that part of the township more accessible than the eastern part. The northeastern part of Miramichi and the southeastern part of Asquith Townships can best be reached by float-equipped aircraft.

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MINERAL EXPLORATION[1]

Exploration activity over much of the Shining Tree area has been previously reported (Carter 1972; 1973; 1974; 1975). Recorded prospecting in Miramichi and Asquith Townships began in 1911 and has continued intermittently until the present time. Almost all of the exploration work was concentrated in Asquith Township. The only recorded prospecting activity for Miramichi Township was for 1972.

Asquith Township

Gold was first found in the map-area in north-central Asquith Township, near its border with Churchill Township, in 1911 on claim 2196 (WD 1151) by F. Gosselin, A. Frith, and C. Speed. Considerable trenching, pitting and systematic sampling were carried out after the discovery, by V. Pakowsky in 1912, Col. R.P. Rogers M.E. in 1922, Gosselin Gold Mines Limited in 1928 and 1929, McIntyre Porcupine Mines Limited probably in the 1930s, by D.K. Burke in 1937, and by Bolduc Gold Mines Limited in 1959. In 1973 Noranda Exploration Company Limited carried out geological mapping and a magnetometer survey, and sank five packsack-drill holes for a total length of 105 m (345 feet). In 1975 Tri-bridge Consolidated Gold Mines Limited carried out geological mapping and drilled three diamond drill holes for a total of 324.6 m (1,065 feet).

In 1912, R. Holding carried out trenching on a gold deposit discovered in that year in east-central Asquith Township at Macdonald Lake. Development work consisted of the sinking of three shafts; one to about 15 m (50 feet), inclined 70 degrees SE with a 3 m (10 feet) drift at the 9 m (30 feet) level; a two-compartment shaft sunk to 27 m (90 feet) and inclined 72 degrees SE, and a third sunk to 30 m (100 feet).

In 1914, E. Steep sank a 30 m (100 feet) shaft, inclined 85 degrees to the south, on an east-trending shear zone near the shore of Shining Tree Lake. Then, in 1973, geological mapping, an electromagnetic survey and a programme of diamond drilling were carried out by Vintage Mines Limited. A total of six holes for a total length of 308.1 m (1,011 feet) were sunk, five in the area of the shaft. An attempt was also made to de-water the shaft in the same year, without success.

In or prior to 1919, J. Peddle carried out trenching on quartz veins in eastern Asquith Township near its border with Fawcett Township. These deposits later constituted the Buckingham Mine. By 1925, when the mine was closed down, a shaft had been sunk to 55.5 m (182 feet) and inclined 60 degrees S, with about 150 m (500 feet) of drifting. Three diamond drill holes had also been drilled for a total of 411 m (1,350 feet) by this time. In 1929, geological mapping was carried out by A.A. Lee, and D.A. Mutch.

From about 1919 to 1936 pitting, trenching and sampling were carried out on veins on the original Kubiak property located at Seager Lake in the eastern part of Asquith Township. Geological mapping was carried out by D.K. Burke in 1936.

In 1919 considerable trenching was done on the original MacRae property on the shore of Shining Tree Lake. Later, in 1963, A. Jutras drilled six diamond drill holes for 70.1 m (237 feet) on the property.

In 1969, H. Johnston carried out pitting, trenching and diamond drilling on his property in northeastern Asquith Township. Seven drill holes totalling 90.5 m (297 feet) were put down.

In 1971, T. Gledhill carried out a magnetometer and an electromagnetic survey on the property of Winnebago Mines Limited in the northeastern part of Asquith Township.

In the same year, 1971, Barringer Research Limited carried out a magnetometer and electromagnetic survey for Royal Mining Corporation on their claim group in northeast Asquith Township.

In 1972, W.R. Miller carried out a magnetometer and electromagnetic survey for Midvale Explorations Limited, and later in the year Barringer Research Limited carried out a gravity and level survey for the same company. The property is located in central Asquith Township.

In 1974-1975, A. Saville carried out pitting and trenching on his claim group at Moorecamp Lake in north-central Asquith Township.

In 1975, S. Mourin carried out a magnetometer and an electromagnetic survey on the property of Kayak Explorations Limited in the central part of the township.

During the summer of 1976 Kayak Explorations Limited was carrying out diamond drilling on the former Jesse James showing in central Asquith Township.

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[1] Information from Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake.

Miramichi Township

In 1972 Proto Exploratons and Holdings Incorporated carried out trenching on their property at Olga Lake in east-central Miramichi Township on a copper showing.

GENERAL GEOLOGY

The history of geologic mapping for most of the Shining Tree area has been documented by Carter (1972; 1973; 1974; 1975). The first systematic mapping in the Miramichi-Asquith Township area was carried out by W.H. Collins in the period 1910-1913 (Collins 1911; 1912; 1917). During this time Miramichi and Asquith Townships were mapped at a scale of 1 inch to 4 miles (1:253,440), and Asquith Township itself in greater detail at a scale of 1 inch to 1 mile (1:63,360). At the same time, in 1911, Stewart (1912) mapped the northeastern portion of Asquith Township at a scale of 1 inch to ½ mile (1:31,680), and re-mapped the same part of the township at a scale of 1 inch to 1 mile in 1912 (Stewart 1913). Following this, in 1919, Hopkins (1920) re-mapped the northeastern part of Asquith Township at a scale of 1 inch to ½ mile. The last systematic mapping in the area, before the present survey, was carried out in 1933 by Laird (1934) who mapped most of the upper part of Asquith and Miramichi Townships at a scale of 1 inch to 1 mile.

The Shining Tree area is underlain by Early to Late Precambrian rocks which are covered by a mantle of Pleistocene and Recent deposits.

The Early Precambrian rocks comprise an interlayered suite of mafic to felsic subalkalic metavolcanics, mafic to intermediate alkalic metavolcanics, clastic, siliceous and ferruginous metasediments, and ultramafic rocks, intruded by gabbroic plutons and intermediate to felsic plutonic rocks. All these are cut by three sets of Early to Late Precambrian diabase dikes which trend NNW to NNE, northeasterly, and approximately east respectively. The Middle Precambrian rocks comprise Cobalt Group clastic sedimentary rocks of the Huronian Supergroup which are intruded by Nipissing-type diabase sills and dikes. Phanerozoic rocks are represented by Pleistocene sands, gravels and alluvium, the sands covering large areas in the western part of the area.

Miramichi and Asquith Townships

In Miramichi and Asquith Townships, the Early Precambrian rocks comprise a suite of mafic to felsic metavolcanics with intercalated ultramafic rocks and metasediments. This suite is intruded by intermediate to felsic plutonic rocks and diabase dikes. Chemically, the metavolcanics are believed to comprise a suite of subalkalic rocks, consisting of basalt, andesite, dacite, and rhyolite extruded as flows. The mafic and intermediate flows, which show pillowed structures, were extruded subaqueously. The metavolcanics are confined to northern Asquith Township and northeastern Miramichi Township. Basaltic rocks are the dominant lithological type. The metasediments consist primarily of interflow chert and arkose. The mafic metavolcanics have been converted to mafic hornfels and amphibolite in the vicinity of the granitic rocks. The intrusive, intermediate to felsic plutonic rocks range from diorite to granite in composition, are massive, gneissic and porphyritic. The mafic minerals in these rocks are hornblende and biotite. One exposure of muscovite granite was encountered. The porphyritic granite is pink in colour and contains anhedral quartz phenocrysts up to 1.3 cm (½ inch) and euhedral phenocrysts of pale pink to red feldspars up to 1.9 cm (¾ inch) long. The diabase dikes range from 0.3 m (1 foot) to 90 m (300 feet) wide but the commonest width is from 30 m (100 feet) to 60 m (200 feet) wide. The trend of these dikes varies from N5E to N20W, but the majority trend N10W. The diabase is usually non-porphyritic, black and magnetic with a dark brown rusty weathered surface. Porphyritic and glomeroporphyritic dikes occur rarely.

The Middle Precambrian is represented by Cobalt Group conglomerate and Nipissing Diabase. Only one exposure of Cobalt Group conglomerate was located in Miramichi Township and Nipissing Diabase was observed in small outcrops in northeastern Asquith Township.

Pleistocene deposits comprise sand, gravel and alluvium, sand being the most widespread, and is best developed as a widespread sand plain in southwestern Miramichi Township and in rolling country in west-central and northwestern Miramichi Township.

STRUCTURAL GEOLOGY

The regional structure in the Early Precambrian of the Shining Tree area is a doubly plunging synclinorium, the median axis of which trends east in the northwestern part of the area and plunges easterly. This axis swings to a SSE trend in the eastern part of the map-area and plunges NNW. In Cabot Township and northern Kelvin Township the rocks of the northern limb strike northeasterly and face southeast, and in Asquith and Fawcett Townships, on the southern limb, the rocks strike northwesterly and face northeast. The Middle Precambrian rocks are flat-lying in the eastern part of the map-area, but dip about 20 degrees northeasterly in the northeastern corner of the area. These rocks are cut by northwesterly trending wrench faults, the most important being the Mattagami Lake Fault, the Elephant Head Lake Fault, the Michiwakenda Lake Fault and the Grassy Lake Fault. Where the movement on these faults could be determined, it was found to be left-lateral with a component of the movement in a vertical direction.

Miramichi and Asquith Townships

In Miramichi and Asquith Townships the Early Precambrian metavolcanic-metasedimentary rocks are tightly folded along gently sinuous NNW-trending axes. These rocks have a well developed foliation in the aureole of the granitic pluton. Two trends are apparent: one trend is east and the other is about N30W. The latter trend could represent an axial plane foliation. The east-trending foliation is the better developed. A gneissic structure is developed in the granitic rocks near the contact with the volcanic rocks. The trend of the gneissosity is approximately parallel to the contact of the granitic and volcanic rocks. Four major faults cross the area: the Papoose Creek Fault which trends N30E, the Jesse James Creek Fault which trends north, the Elephant Head Lake Fault which trends N30W, and the Mattagami Lake Fault which trends N15W.

ECONOMIC GEOLOGY[1]

Economically the most important deposits are gold veins, and production was realised from the Ronda Mine and Tyranite Mine. The gold veins occur in metavolcanic-metasedimentary host rocks in shear zones and fissures. Most of the gold bearing veins are in the mafic metavolcanics and are more numerous on the southern limb of the synclinorium.

Miramichi and Asquith Townships

COPPER

Copper occurs as chalcopyrite in central Asquith Township at the Midvale showing in "...an evenly banded rhyolite flow or metasiltstone" (W. Walker, 1971, Report prepared for Midvale Explorations Limited[1]). The showing was re-examined in 1975 by J.D. McCannell who described the showing thus: "...the rock is quite siliceous and carried considerable chalcopyrite and pyrite in seams and disseminated blobs across a width of 1.5 feet [0.5 m] with sulphide stringers up to one inch [3 cm] in width extending in the wall rock. The general strike of the zone appeared to be roughly north-south. A sample ... across the 1.5 feet [0.5 m] of mineralization, returned an assay of 3.14% copper and a trace of gold."

GOLD

Gold occurs in quartz veins and narrow quartz stringers mostly in foliated and sheared metabasalts. The trend of the veins and stringers is parallel to the foliation. The most important deposits are the Buckingham, Gosselin, Holding, Jesse James, Kubiak and Steep.

The Buckingham deposit is located near the central part of the eastern boundary of Asquith Township. The main deposit consists of a 300 m (1,000 feet) long, 1.2 m (4 feet) wide, discontinuously exposed shear zone containing quartz stringers. The zone strikes N86E and dips 65-70S. The host rock is sheared pillowed basalt. Gold occurs associated with chalcopyrite, calcite and tourmaline. The best assay from a grab sample taken by A.W. Vale in 1926 was 29.09 ounces gold per ton. The best assay from channel sampling by D.K. Burke taken in 1936 was $15.20 over 0.43 m (1.8 feet) (gold at $35.03 per ounce, 1936 price).

The Gosselin or Main vein, where exposed in Asquith Township, is a quartz vein 200 m

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[1] Information from Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake.

(650 feet) long and 0.3-6 m (1-20 feet) wide. It strikes N15W and dips vertically and is located near the central part of the Asquith-Churchill Township boundary. The vein is enclosed in altered and carbonatized rusty-weathering pillowed basalt, cut by felsite or rhyolite. The best assay from chip sampling by A.C. Amos in 1959 returned 0.02 ounces Au per ton over 1.3 m (4.6 feet). The best assay obtained from diamond drilling done in 1975 by Tri-bridge Consolidated Gold Mines Limited was 0.09 ounces Au per ton over a core length of 3 m (10 feet).

The Holding Vein, located near the southeastern end of Macdonald Lake, Asquith Township was described as a deposit consisting of numerous parallel quartz stringers, up to 10 cm (4 inches) wide and occasionally 0.3 m (1 foot) in width in amphibolite or hornblende schist. The schist zone was 0.9-1.5 m (3-5 feet) wide, and 60 m (200 feet) long at the surface, striking N63E and dipping 65-72S. A channel sample of the vein taken by D.K. Burke in 1937 returned an assay of $2.40 over 0.82 m (2.7 feet) (gold at $34.99 per ounce, 1937 price).

The Jesse James Vein, located in central Asquith Township, was a quartz vein 79.5 m (265 feet) long and 2-3.6 m (5-12 feet) wide striking N70W and dipping 50S enclosed in sheared basalt. Gold was associated with chalcopyrite, pyrite and galena. In 1931 it was reported that the then owner of the vein, E.B. James, recovered 250 ounces gold from a trench on the vein. A grab sample from quartz at the dump near the vein taken by J.D. McCannell in 1975, returned an assay of 0.09 ounces Au per ton.

The Kubiak deposit consists of various quartz veins in shears striking NNE, NNW, and east in basalt. These veins are exposed discontinuously over distances ranging from 45-750 m (150-2,500 feet). The best assay from a grab sample taken by D.K. Burke in 1936 was $7.20 in gold per ton (gold at $35.03, 1936 price).

The Steep Vein was a quartz vein 200 m (700 feet) long and 0.76 m (2.5 feet) wide enclosed in 1.5 m (5 feet) of sheared pillowed basalt occurring near the shore in West Shining Tree Lake. The gold was associated with zinc blende, galena, chalcopyrite, pyrite and talc. The best assay from an unstated type of sampling of the shaft by T.H. Rae at an unknown date, reported by D.K. Burke in 1937, was $25.80 over 0.3 m (1 foot). A grab sample taken from the vein by J.D. McCannell in 1974 returned an assay of 1.08 ounces Au per ton and 0.14 ounces Au per ton over 0.2 m (0.7 feet) of drill core from below the shaft on the vein.

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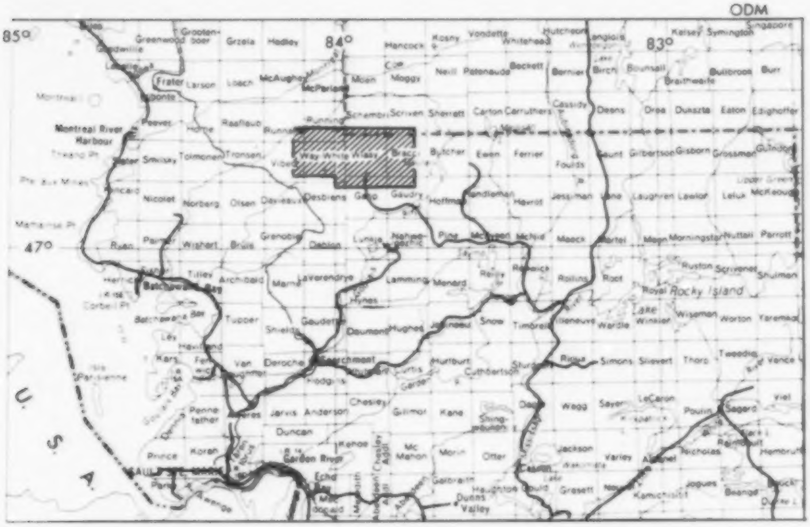
NO. 18 QUINN LAKE AREA

DISTRICTS OF ALGOMA AND SUDBURY

G.M. Siragusa[1]



LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

LOCATION AND ACCESS

The present map-area includes an area bounded by Latitudes 47°07′30″ and 47°15′N and Longitudes 83°45′ and 84°W, and another area bounded by Latitudes 47°10′ and 47°15′N and Longitudes 84° and 84°05′30″W. These areas comprise southern portions of Running, Schembri, and Scriven Townships, northern portions of Gapp and Gaudry Townships, the northeastern corner of Desbiens Township, the whole of Wlasy Township, most of Way-White Township, and the western two-thirds of Bracci Township, for a total of 329 km² (127 square miles).

The centre of the map-area is 80 km (50 miles) NNE of Sault Ste. Marie. A bush road approximately 58 km (36 miles) long connects the southern tip of Quinn Lake (northern Gapp Township) with the village of Searchmont, and thence with Heyden via Highway 556, and Sault Ste. Marie via Highway 17; the distance of Quinn Lake from Sault Ste. Marie via Searchmont and Heyden is about 104 km (65 miles). Another bush road which is a recent extension of the Tribag Mine Road, provides limited access to the western side of the St. Clair Lake area of southwestern Running Township, at the very northwest corner of the map-area. This road is approximately 72 km (45 miles) long and connects with Highway 17 at Batchawana Bay 64 km (40 miles) north of Sault Ste. Marie. Winter lumber roads intersect parts of the map-area but owing to their poor conditions they do not offer practical means of communication within the area. About 140 lakes are scattered throughout the map-area. Of these, Quinn, Little Quinn, Hodgson, Browne, Snyder, and Dyson Lakes are access points to the central third of the map-area by float-equipped fixed wing aircraft; Emerson Lake, North Chubb Lake, and the largest lake at the boundary of Bracci and

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Gaudry Townships are useful for the same purpose in the eastern third of the map-area. Virtually all the lakes in the western third of the map-area are unaccessible by fixed wing aircraft, being either too small, or too shallow as, for instance, Dismal Lake. Consequently the only practical means of access to the western part of the map-area, is by helicopter; helicopter service is available in Sault Ste. Marie. The drainage system of the area includes many streams the majority of which are useless as canoe routes, because of the shallowness of the water during most of the summer and frequency of log jams and/or beaver dams.

ODM Geological Map No. 34d (E.S. Moore 1926) and the Batchawana-Hubert sheet of the Algoma Central Railway geological map (Algoma Central Railway 1964) cover the western half of the map-area at the scale of 1 inch to 1 mile (1:63,360); ODM-GSC Aeromagnetic Maps 2202G and 2215G cover the western third and the eastern two-thirds of the map-area respectively, also at the scale of 1 inch to 1 mile.

MINERAL EXPLORATION[1]

With the exception of a group of 18 claims located across the central segment of the southern boundary of the map-area, all the areas where recorded exploration has occurred are within the supracrustal rocks underlying the western half of the map-area; the group of 18 claims was covered by ground magnetic and electromagnetic surveys carried out, presumably in 1968, by Humbleford Exploration Limited.

The Browne-Butter Tin-Dyson Lakes area of northern Gapp and southern Wlasy Townships has recurrently attracted exploration which has included i) dip needle surveys by Mining Research Corporation Limited over a group of 46 claims, and by Mekatina Iron Mines Incorporated over a group of 27 claims, in 1944 and 1950, respectively, and ii) dip needle and geological mapping of 6 claims, geological mapping of 15 claims, drilling of 12 holes for a total of 776 m (2,545 feet), and geological mapping of 3 claims, carried out by the Exploration Department of Algoma Steel Corporation Limited in 1953, 1959, 1965, and 1966, respectively.

Way-White Township has also received considerable attention in both past and present times. In 1956 exploration work was carried out in this township by Technical Mine Consultants on behalf of a syndicate known as the Five Townships Syndicate which was formed for the purpose of acquiring exploration rights to five townships controlled by Algoma Central Railway. The exploration program included two airborne electromagnetic surveys, staking of 190 claims, and detailed geophysical, geological, and geochemical investigations at various localities of the township. A total of approximately 43037 m (141,200 feet) of line cutting and some local trenching were carried out during the program. During the summer of 1976 Way-White Township was examined as part of a helicopter supported exploration program by HBOG Mining Limited over an area extending beyond the northern and southern boundaries of the present map-area, and, at the same time, Metallgesellschaft Canada Limited was active in the Wart-Mongoose Lakes area of the adjacent Vibert Township. The exploration program carried out by the former company included geophysical and geological mapping and some local blasting and drilling.

Northwestern Wlasy Township and Running Township have attracted some exploration activity in recent years. Presumably before 1960, Modern Geophysical Limited completed a ground magnetometer survey on a group of ten claims in the Vacher Lake area of Wlasy Township. This work was done on behalf of Windy Hill Mining Corporation Limited and in 1960 five drill holes for a total of 459 m (1,506 feet) were completed in the Vacher Lake area by Principle Strategic Minerals Limited. In early 1974 Asarco Exploration Company of Canada Limited entered a joint venture arrangement with Algoma Central Railway with respect to the mineral rights of Running Township, and during May of the same year electromagnetic and magnetic surveys were flown by Kenting Earth Sciences Limited. Geological and geophysical ground follow-up of this work was carried out by Asarco Exploration Company of Canada Limited in June and August of the same year.

At the time of writing it is not known to what extent the portions of Running and Desbiens Townships which are within the map-area might have been involved in the exploration program carried out in 1976 by HBOG Mining Limited.

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[1] Information from Assessment Files Research Office, Ontario Division of Mines, Toronto, except for information relevant to work done in 1976.

GENERAL GEOLOGY

The western half of the map-area is underlain by metavolcanics which are part of an Early Precambrian metavolcanic-metasedimentary belt extending beyond the northern, southern, and western boundaries of the area. The metavolcanics within the map-area form a northwest-trending sequence with a width of approximately 10 271 m (33,700 feet); metamorphosed basaltic flows interbedded with subordinate agglomeratic and tuffaceous dacitic units and lesser felsic metavolcanics units account for about 7800 m (25,700 feet), or slightly over three-quarters of the width of the sequence. This dominantly mafic series underlies the portion of Running Township within the map-area, part of southern Schembri Township, most of Way-White Township, the northeast corner of Desbiens Township, all but the northeast corner of the portion of Gapp Township within the map-area, and the southwestern, western, and northwestern parts of Wlasy Township. The metavolcanics of the mafic series differ from the mafic metavolcanics of the Batchawana-Pangis area (Siragusa 1975) in that they are generally lighter in colour and grey rather than green in hue; at the time of writing no chemical data are yet available for comparison but it is suggested that these differences reflect variations in iron content rather than significant difference in silica content. A felsic series consisting of sheared tuffaceous and agglomeratic metavolcanics essentially of rhyolitic composition accounts for the remaining 2400 m (8,000 feet) of the sequence. These rocks underlie the central part of northern Desbiens Township, and parts of southern, southwestern, and western Way-White Township.

Pillowed flows occur within the mafic series but owing to the deformed state of these structures and, to a lesser extent, to unfavourable geometric relationships in some of the relatively undeformed outcrops, no top determinations could be made in most of the observed occurrences. Southwest-facing pillows plunging northeast at steep angles, and thus indicating moderate overturning of the volcanic rocks, were noted at a few localities. The felsic series is thought to stratigraphically overlie the mafic series and the mafic metavolcanics of southwest Wlasy Township are regarded as the basal section of the volcanic sequence in the map-area. Bands of oxide-facies iron formation which are particularly conspicuous in the Butter Tin-Boyle Lakes area of Gapp and Wlasy Townships, and in the Vacher Lake area of Wlasy Township, are interbedded with the mafic metavolcanics in the basal section of the sequence. The iron formation occurs close, or adjacent to, the contact of the metavolcanics with the granitic rocks. The outline of this contact is best described as a parabola with axis trending E-W, concavity toward the east, vertex in west-central Wlasy Township, and intersecting the northern and southern boundaries of this township at about their middle points. The granitic rocks underlying the map-area east of this curve are largely uniform, and to a much lesser extent migmatitic.

The volcanic and the granitic rocks are cut by dominantly northwest-trending diabase dikes which typically occur as topographic ridges. Two types of diabase are present one of which is light grey and the other generally dark green.

STRUCTURAL GEOLOGY

Metamorphic foliation is generally well developed, although locally absent, in the metavolcanics of the mafic series, and is very well developed in those of the felsic series. The dominant trend of foliation, and of the compositional layering in the metavolcanics is northwest, and the dominant direction of dip of foliation is northeast at steep angles. Northeast- and northwest-trending joints and incipient faults are widespread in the granitic rocks; the northwest-trending joints and the metamorphic foliation in the metavolcanics have apparently controlled to some extent the intrusion of diabase.

ECONOMIC GEOLOGY

It is apparent that most of the older exploration activity was aimed at establishing the potential of the iron deposits of the area; the following refers to work done in 1951 by Mekatina Iron Mines Incorporated (see "Mineral Exploration" section): "No reliable estimate of tonnage can be made from the information available. It is estimated that in the broad area south and west of Maud Lake in claim 15705 and on the margins of adjoining ones is a potential ore body 800′ x 1100′ [240 m by 330 m] which could average 10 million tons per 100 feet [30 m] of depth. The other bands of iron formation where exposed indicate a workable grade over as much as 270′ [82 m] in width and this would make the whole property a potential producer of at least 50 million tons per 100 feet. There is a possibility of three times that much" (File No. 63/263, *Mekatina Iron Mines*, Assessment Files Research Office, Toronto).

The target of the exploration work in more recent years was apparently the localization of massive sulphide mineralization; no recorded information of further development was found with reference to the exploration carried out by the Five Townships Syndicate in 1956. The area explored by the Five Townships Syndicate is mostly within the contact zone of the felsic and mafic series. At the end of the exploration program carried out in 1974 by Asarco Exploration Company of Canada Limited, nothing of economic interest was found and it was recommended no further work be carried out on the property at that time. At the time of writing no data are available on the results of the work done by HBOG Mining Limited during the summer of 1976. The area covered by HBOG Mining Limited includes the whole western half of the map-area and extends beyond the northern and southern boundaries of the latter.

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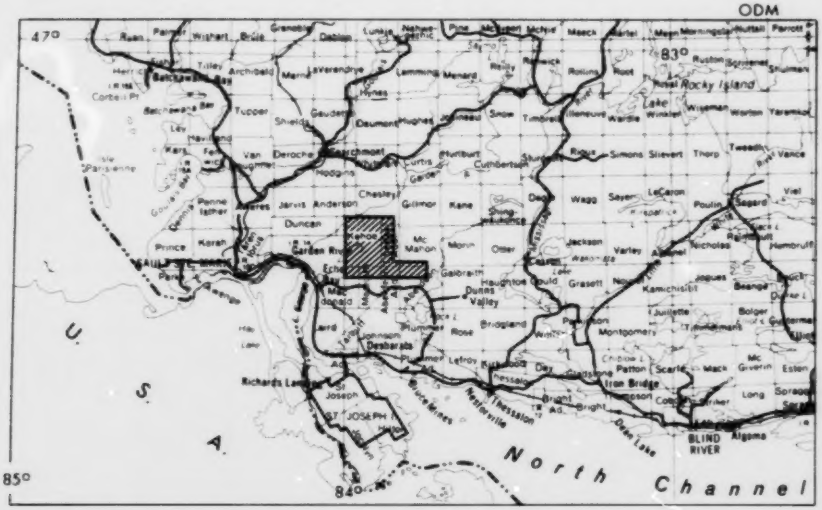
NO. 19 TWO HORSE LAKE AREA

DISTRICT OF ALGOMA

Gerald Bennett[1]



LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

LOCATION AND ACCESS

The boundary of the map-area may be described by the co-ordinates of two adjoining rectangles. The smaller rectangle is bounded by Latitudes 46°30′ and 46°31′47″N and Longitudes 83°45′ and 83°50′20″W. The larger rectangle is bounded by Latitudes 46°30′ and 46°37′30″N, and Longitudes 83°50′20″ and 84°00′W. The area comprises almost all of Kehoe Township and all of Chesley Additional Township, as well as adjoining parts of Aberdeen, Aberdeen Additional, Chesley, Macdonald and Meredith Townships.

The southern half of the area is easily reached by gravel surfaced all-weather roads from Highway 638. The northern parts of Kehoe and Chesley Additional Townships can only be reached on foot along old logging roads.

MINERAL EXPLORATION

Prospectors were active in the map-area sometime prior to A.P. Coleman's visit to Echo Lake around the turn of the century. Coleman noted that the Austin Copper Mining Company (also referred to as the Austin Mining Company) had sunk two (short) shafts and driven an adit into a copper occurrence north of Echo Lake in Kehoe Township, but that the property had been abandoned several years previously (Coleman 1899, p.124).

In 1955, Lock City Copper Mines Limited did additional rock trenching and some diamond drilling of the above deposit but the results are not available.[2] Denison Mines Limited conducted electromagnetic and self-potential surveys, as well as some geological mapping on the occurrence in 1962. One diamond drill hole was drilled to 12.5 m (41 feet), but results did not warrant further expenditure.[1]

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[1] Geologist, Precambrian Geology Section, Geological Branch, Ontario Division of Mines, Sault Ste. Marie.

[2] Regional Geologist's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie.

In 1968 Gulf Minerals Canada Limited acquired a large block of ground including all of Kehoe and Chesley Additional Townships, as well as much of McMahon, Morin, Macdonald, Meredith, Aberdeen Additional, Aberdeen and Galbraith Townships. In addition to exploration rights obtained by agreements with patent holders, a total of 363 claims were staked by Gulf Minerals Canada Limited. The project was undertaken with the aim of locating Elliot Lake-type uranium deposits within Elliot Lake Group strata, if such could be identified at the surface or within drilling depth.

In November 1968, Gulf Minerals Canada Limited contracted Seigel Associates to carry out airborne electromagnetic, magnetic and radiometric surveys of the property.[1]

In 1968 and 1969, David S. Robertson and Associates conducted a geological field examination of the Gulf Minerals ground and in 1970 a geological field party of Gulf Minerals Canada Limited mapped much of the area.

In 1969 four diamond drill holes totalling 1300 m (4,226 feet) were drilled in an attempt to intersect the Matinenda Formation. The holes were stopped when it was found that the Mississagi Formation, on which the holes were collared, was thrust upon the Gowganda Formation, making it impractical to continue drilling to the Elliot Lake Group strata.[1]

In 1962 A.L. Laframboise optioned to Conwest Exploration Company Limited, a 33-claim group located between Hart Lake and Two Horse Lake in Aberdeen Additional Township. Conwest carried out a trenching program and drilled five diamond drill holes totalling 209 m (658 feet) to evaluate a chalcopyrite and magnetite bearing skarn.[1]

In 1964 the property was optioned to New Senator-Rouyn Limited, who drilled an additional 28 holes totalling 870.8 m (2,856.9 feet).

As of June, 1976, eight claims of the original group are held by F. Guillemette, P. Laverdiere and L.A. Laframboise.

In 1970 Safari Explorations Limited held two groups of three and four claims adjoining the Guillemette-Laverdiere-Laframboise property. In that year induced potential, geochemical and geological surveys were carried out over the property.

Three diamond drill holes totalling 159.8 m (524.3 feet) drilled in 1974, failed to intersect significant mineralization. The claims have since lapsed.[1]

In addition to the above-mentioned mining companies many individual prospectors have been active in the area since the turn of the century.

During the summer of 1976, geologists of Shell Canada Limited mapped and prospected the Huronian volcanics of the Thessalon Formation, north of Aberdeen Lake.

About 600 m (2,000 feet) south of the southeast end of McMahon Lake, an occurrence of quartz pebble conglomerate near the base of the Aberdeen volcanic belt (the Thessalon Formation) was found to be weakly radioactive (2 to 3 times background) when examined by the author.

Similar conglomerate at about the same stratigraphic level outcrops just southeast of the map-area in Lots 3 and 4, Concessions 4(?) and 5 of Aberdeen Township. In 1965 Rio Tinto Canadian Exploration Limited drilled five holes totalling 472.1 m (1,548 feet) on this prospect. Amax Exploration Limited drilled five holes totalling 475.1 m (1,561 feet) through this conglomeratic sequence in 1969. The best assays reported are 0.04 percent U_3O_8 over 1.0 m (3.2 feet).[1]

GENERAL GEOLOGY

The map-area is located in the southwestern part of the Southern Province of the Canadian Shield. All of the rocks of the area are of Precambrian age. An Early Precambrian (Archean) plutonic complex consisting of equigranular and porphyritic quartz monzonite, and various hybrid plutonites ranging from granodiorite to diorite which underlies the northeastern part of Chesley Additional Township forms the oldest geological formation of the area.

The Early Precambrian rocks are overlain unconformably by supracrustal rocks of the Huronian Supergroup of Middle Precambrian age. The lowermost Huronian rocks recognized in the area are represented by a few outcrops of grey subarkose, arkose and grit in the northern portion of Aberdeen Township. These sandstones are stratigraphically and lithologically equivalent to the Livingstone Creek Formation of the Elliot Lake Group (Frarey 1967) in the Thessalon area and the Driving Creek Formation in the Sault Ste. Marie area (McConnell 1926; Frarey 1967).

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[1] Regional Geologist's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie.

In the map-area the lower contact of the Livingstone Creek Formation is probably a fault (the McMahon Lake Fault of Chandler 1973). The Livingstone Creek Formation is overlain by about 1200 m (4,000 feet) of predominantly basaltic flows known as the Thessalon Formation (Frarey 1967). The mafic flows commonly display amygdaloidal flow contacts as well as tabular amygdaloidal units within individual flows. Well developed pillow structures are present at a few places. A massive flow of pink rhyolite(?) is located about 720 m (1,800 feet) above the base of the formation. The mafic volcanics range in colour from pale grey-green through dark green to brownish-black on fresh surfaces. Preliminary examination of thin sections suggests that variations in colour are due largely to variations in the amounts of secondary minerals (mainly chlorite, actinolite, stilpnomelane and epidote) rather than major differences in bulk chemical composition.

Within the lower 150 m (500 feet) of the Thessalon Formation, thin units of sedimentary rocks are interbedded with the mafic flows. The interflow clastic rocks include dark grey to black, fine-grained wacke and siltstone, pink to grey, coarse-grained arkose and grit, and quartz-pebble conglomerate (locally radioactive).

The Ramsay Lake Formation, the lowermost formation of the Hough Lake Group, outcrops on the east shore of Aberdeen Lake and south of Coffee Creek, northwest of Aberdeen Lake. The lower contact of the Ramsay Lake Formation in the map-area is probably a fault contact. The formation is at least 30 m (100 feet) thick, and is predominantly massive, grey weathering, polymictic paraconglomerate consisting of pebble and cobble-sized clasts of grey and pink granitic rocks, mafic volcanic rocks and quartz in a grey to black matrix rich in sand-sized quartz grains.

About 1000 m (3,000 feet) north of Hart Lake in Aberdeen Additional Township, the Ramsay Lake conglomerate is overlain by pale grey, medium to fine-grained subarkose of the Mississagi Formation. Only a metre or two separates outcrops of the Ramsay Lake and the Mississagi Formations, indicating that in this area at least the Pecors Formation is very thin or not present.

The Mississagi Formation extends in a broad belt from the south shore of Aberdeen Lake in Aberdeen Township to the west side of Echo Lake in Kehoe Township. An estimate of the true thickess of the Mississagi Formation is not possible because of faulting. In central Kehoe Township the Mississagi Formation is at least 1200 m (4,000 feet) thick and consists of pale grey, greenish-grey, and pink subarkose, with subordinate pale grey arkose, orthoquartzite, arkosic grit and conglomerate. Near the north end of Echo Lake there are a few massive beds of dark grey wacke and polymictic conglomerates within the pale sandstones of the Mississagi Formation.

Rocks of the Quirke Lake Group are not well exposed in the map-area and correlation is open to doubt in some cases. A thin unit of massive, dark, pebbly wacke on the south face of a hill west of Echo Lake is tentatively correlated with the Bruce Formation on the basis of lithology. It appears to lie upon subarkose of the Mississagi Formation, but is overlain by a laminated argillite which forms the base of the Gowganda Formation in the area.

The tightly folded and brecciated limestone of the Espanola Formation is exposed on the shore of Echo Lake and between Hart and Quigley Lake in northern Aberdeen Additional Township. At the latter locality, the limestone is intruded by a thick body of Nipissing gabbro resulting in the development of amphibole and magnetite-rich skarn adjacent to the gabbro.

The Serpent Formation was not positively identified in the map-area but it may be represented by a thin unit of pale grey subarkose and conglomerate overlying the Espanola Formation at the south end of Quigley Lake. At Marble Point on Echo Lake the Espanola Formation is overlain directly by polymictic conglomerate correlated with the Gowganda Formation of the Cobalt Group.

North of the Echo River Fault (Chandler 1973) the Gowganda Formation of the Cobalt Group lies directly upon the Early Precambrian basement complex, whereas south of the fault the Gowganda Formation unconformably overlies rocks of the Huronian Supergroup. These relationships imply either no deposition of the pre-Cobalt Huronian rocks north of the Echo River or more likely, their erosion as a result of uplift of the northern portion of the area prior to the deposition of the Gowganda rocks.

The Gowganda Formation is a stratified sedimentary complex consisting of a lower sequence of intercalated pebbly siltstone, laminated siltstone, matrix supported and clast supported polymictic conglomerate, pink arkose and subarkose.

The upper sequence consists mainly of

interlaminated grey siltstone, argillite and fine-grained pink to grey subarkose. In contrast to the overlying Lorrain Formation the Gowganda Formation is virtually devoid of primary current structures.

The base of the Lorrain Formation consists of about 300 m (1,000 feet) of fine- to medium-grained, pink weathering pink to grey arkose and subarkose. Above this arkosic sequence are 15 to 60 m (50 to 200 feet) of grey to maroon and purple siltstone and very fine-grained, micaceous arkose which commonly displays well developed ripple marks. The grey and purple siltstone is overlain by a thin unit of purple to grey, medium-grained subarkose devoid of pebble layers.

Above the grey arkose member there is about 1200 to 1500 m (4,000 to 5,000 feet) of red and white quartzite with beds of striking, jasper-bearing pebble conglomerate commonly known in the area as "puddingstone". The top of the Lorrain Formation is not found in the map-area.

Large, apparently subconcordant bodies of Nipissing gabbro, with granophyric phases, intrude all of the Huronian rocks. West of Kinch Lake in northwestern Kehoe Township a large body of anorthositic gabbro, olivine(?) gabbro and minor peridotite extends for at least 1.5 km (1 mile) in a northeast direction from the base of a Nipissing sill. This highly discordant intrusion may represent a more mafic "keel" or feeder extending downward from the Nipissing sill.

STRUCTURAL GEOLOGY

Throughout most of the map-area, bedding in the Huronian Formations strikes northwest to WNW and dips at 20 to 50 degrees to the southwest. Abrupt termination of formations and negative topographic lineaments serve to outline three major faults. Two northwest striking faults, the McMahon Lake Fault (Chandler 1973) and the Aberdeen Lake Fault have down-thrown northeast blocks. The Aberdeen Lake Fault has been shown by diamond drilling to be a thrust fault (Regional Geologist's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie). The McMahon Fault is probably a thrust fault also. The Echo River Fault strikes east to northeast along the valley of the Echo River and is probably older than the McMahon Lake and Aberdeen Lake faults.

ECONOMIC GEOLOGY

Most of the occurrences of sulphide minerals in the area which have attracted the attention of prospectors are pyrite-chalcopyrite deposits with a quartz or quartz-carbonate (generally calcite) gangue, either within or close to large Nipissing diabase intrusions. The Austin Copper prospect is typical of such a deposit.

At the Austin Copper Prospect an arcurate mineralized zone of highly variable width (generally less than 3 m or 10 feet) extends about 300 m (1,000 feet) in a northwest to westerly direction. The mineralization consists of erratic seams of chalcopyrite and pyrite with hematite within quartz veins (up to 60 cm wide) and following fractures in siltstone. The siltstone is locally altered (probably silicified and albitized) to a white or pink rock within the mineralized zone. Of 19 channel samples analyzed for Denison Mines Limited in 1968, only four returned over 1 percent copper. The best assay was 2.50 percent copper over 3 m (10 feet) with 0.05 ounces of silver per ton and trace gold.[1] A grab sample taken by members of the writer's field party in 1976 was analyzed by the Mineral Research Branch, Ontario Division of Mines, and returned 11.0 percent copper, 0.29 ounces silver per ton and 0.03 ounces of gold per ton.

The Guillemette-Laverdiere-Laframboise Prospect consists of seams and disseminated blebs of chalcopyrite and magnetite in a dark green to black amphibole-rich skarn formed at the contact between a large Nipissing gabbro intrusion and limestone of the Espanola Formation. A report by Conwest geologist, A.S. Ashton, states that chalcopyrite is contained within a lens 40 m (130 feet) long and having a maximum width of 10.7 m (35 feet) striking about S55E and dipping about 40 degrees to the southwest.[1]

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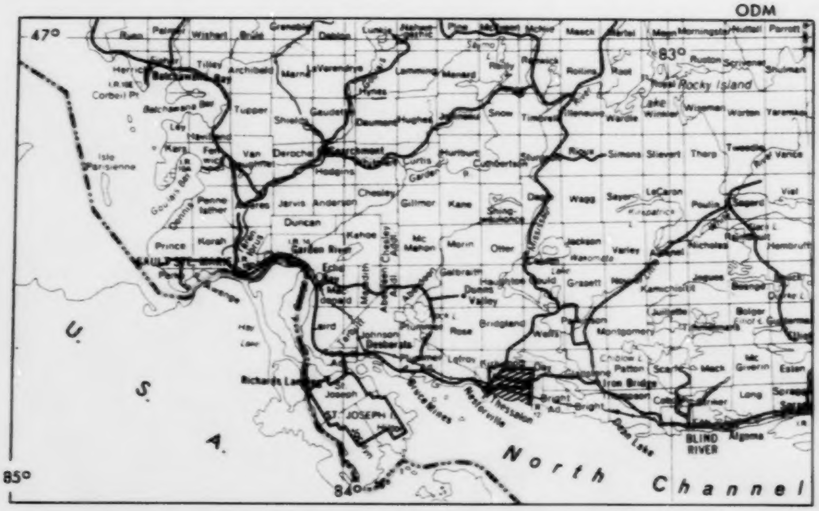
NO. 20 HURONIAN VOLCANISM IN THE THESSALON AREA

DISTRICT OF ALGOMA

Gerald Bennett[1]



LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

INTRODUCTION

During the latter half of August and early September, 1976 geological mapping at a scale of 1 inch to ¼ mile (1:15,840) was carried out over the Huronian volcanic rocks of the Thessalon area as part of a study of Huronian volcanism, undertaken by the writer and D.G. Innes.

The area mapped includes that underlain by the Huronian volcanic belt, the adjacent sedimentary rocks and basement granitic rocks. The boundaries coincide approximately with Longitudes 83°27′ and 83°34′W and Latitudes 46°16′ and 46°23′N. The town of Thessalon is in the southwestern corner of the area. The area is easily accessible by gravel surfaced all-weather roads and by Highways 17 and 129.

MINERAL EXPLORATION

During the summer of 1976, geologists of Shell Canada Limited were engaged in geological mapping and prospecting in the area. In 1976 Conwest Exploration Limited drilled three diamond drill holes totalling 2856 m (9,359 feet) collared on islands in Lake Huron. One of these holes drilled about 0.8 km (1 mile) west of the town of Thessalon intersected 514.8 m (1,688 feet) of mafic volcanic rocks of the Thessalon Formation. No mineralization was reported in drill logs.[2]

GENERAL GEOLOGY

Early Precambrian (Archean) rocks which form the basement to the Huronian sequence of the Thessalon area are predominantly coarse-grained, pink, equigranular and porphyritic quartz monzonite which locally contains a high proportion of mafic *schlieren* and angular amphibolitic inclusions grading to gneissic, hybrid rocks and migmatites.

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[1] Geologist, Precambrian Geology Section, Geological Branch, Ontario Division of Mines, Sault Ste. Marie.

[2] Regional Geologist's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie.

Along the major unconformity between the Early Precambrian and the Huronian rocks the granitic rocks are locally white or greenish-grey, rather than the more usual pink and are traversed by veins of pale grey chert. The white to green rock represents pre-Huronian paleoweathering of the basement. This regolith is absent or very thin in some places but locally may be as much as 100 m (a few hundred feet) thick.

The Livingstone Creek Formation which forms the basal formation of the Huronian Supergroup in the area consists mainly of fine- to medium-grained, well sorted, cross-bedded grey sandstone and granite-cobble to boulder conglomerate. The latter is well exposed on islands in Lake Huron whereas sandstones are more prominent north of Highway 17. The Livingstone Creek Formation is up to 100 m (300 feet) thick but may be absent in some areas.

Conformably overlying the Livingstone Creek Formation is a 600 to 1200 m (2,000 to 4,000 feet) thick sequence of volcanic rocks and minor sedimentary rocks termed the Thessalon Formation by Frarey (1967).

The initiation of volcanism in the area coincided with the deposition of a thin unit of coarse-grained, pink to grey arkose, subarkose and locally uraniferous quartz-pebble conglomerate. This sedimentary assemblage, lithologically distinct from the underlying Livingstone Creek Formation, was found in some places to lie between the Livingstone Creek Formation and the basalt of the Thessalon Formation and elsewhere in the area to be intercalated with flows close to the base of the Thessalon Formation. This arkose and conglomerate unit is lithologically similar to sandstone and (in part uraniferous) conglomerate near the base of the Thessalon Formation, both in the Sault Ste. Marie and Aberdeen Lake areas (Bennett *et al.* 1976; Bennett, *this volume, preceding paper*).

The Thessalon Formation consists for the most part of basaltic flows up to 30 m (100 feet) thick, which appear to be the products of extensive fissure eruptions. The lack of pillow structures indicate subaerial conditions. The basalts are generally dark grey, grey-green to almost black on fresh surfaces. Quartz, epidote, chlorite and calcite-filled amygdules are widely distributed. Grey-green porphyritic basalt forms broad units within non-porphyritic basalt northeast from Bullhead Bay to Highway 17.

Felsic and intermediate (?) volcanic rocks are found mainly within the southwest quarter of the belt where they form lenticular units at least 100 m (300 feet) thick and up to 2000 m (6,000 feet) along strike.

Felsic volcanic rocks are predominantly pinkish-grey to bright pink, generally non-porphyritic, amygdaloidal rhyodacite or rhyolite. Some flows may be of trachytic composition. Locally, aphanitic, hard, purplish-black flows of uncertain classification are intermixed with pale felsic flows.

Thin units of tuff-breccia are intercalated with felsic volcanic rocks south of Thessalon station and north of Wawa Island.

The Thessalon Formation is overlain by fine- to medium-grained, pale pink to grey subarkose correlated with the Mississagi Formation. Coarse, polymictic conglomerate, rich in mafic volcanic clasts and resembling the Ramsay Lake Formation, was found at two localities near or at the base of the Mississagi Formation.

A series of northwest- to west-striking diabase dikes, presumably of Nipissing age, intrude all of the rocks exposed in the area.

STRUCTURAL GEOLOGY

The attitudes of beds within the overlying and underlying sedimentary rocks and the attitudes of flow contacts along the shore of Lake Huron in the eastern part of the belt indicate that the Thessalon Formation as a whole dips from 15 to 30 degrees to the west or northwest. There is evidence of flexures or other structural disturbances within the belt as shown by the northwest strike and steep, southwesterly dip of flow contacts in the southwestern part of the belt.

Topographic lineaments and the displacement of formations indicate both northeast and northwest fault directions.

ECONOMIC GEOLOGY

Uranium

A bed of quartz-pebble conglomerate and arkosic grit about 30 cm (1 foot) thick occurs within coarse-grained pink to grey arkose at the western edge of a farmer's field about 2000 m (6,000 feet) south of Kirkwood Lake, (Longitude 83°28′24″W, Latitude 46°20′26″N). The conglomerate contains about 15 percent of fine pyrite and is radioactive up to 10 times background. Radioactivity is attributable to approximately equal parts uranium and thorium. The conglomerate is located within mafic volcanic rocks near the base of the Thessalon Formation.

At the southern end of Cullis Lake in Day Township, 7 to 10 m (20 to 30 feet) of coarse, pink arkose and subarkose overlies grey subarkose of the Livingstone Creek Formation. At the base of the pink arkose is about 50 to 75 cm (1.5 to 2.5 feet) of quartz pebble conglomerate which is locally pyritic, particularly near the base. This occurrence was not tested directly for radioactivity. Samples of the pyritic conglomerate are weakly radioactive (up to three times background).

Sulphide Mineralization

Disseminated grains and small pods (1-2 cm) of pyrite and an unidentified grey metallic mineral (arsenide?) occurs almost exclusively within syenitic or granophyric patches within Nipissing diabase on the northwest shore of Cullis Lake. The sulphide-bearing portion of the diabase extends for about 20 m (60 feet) in a northwest direction along the shore of the lake, and about 4 m (12 feet) up the face of the outcrop. The overall sulphide and arsenide(?) content of the mineralized area is estimated to be less than 1 percent. There is no evidence of previous work on this occurrence.

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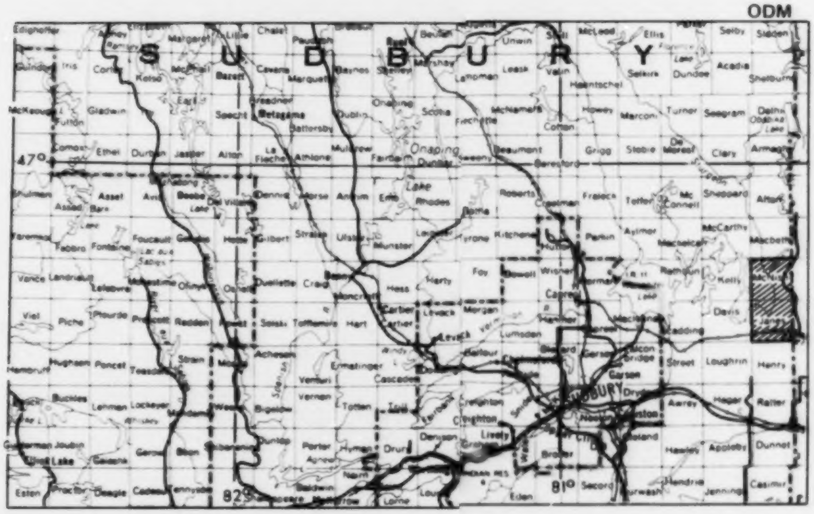
NO. 21 JANES AND McNISH TOWNSHIPS

DISTRICT OF SUDBURY

B. Dressler[1]



LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

LOCATION AND ACCESS

Janes and McNish Townships are located approximately 55 km (35 miles) northeast of Sudbury, 11 km (7 miles) west of River Valley and bounded by Latitudes 46°37′30″ and 46°48′N and Longitudes 80°17′ and 80°25′W. The map-area lies south of Macbeth Township mapped by H.D. Meyn (1973) and east of Kelly and Davis Townships (J.E. Thomson and K.D. Card 1963). It is part of the River Valley map-sheet (S.B. Lumbers 1973) and the Janes, McNish, Pardo and Dana Townships area mapped by E.L. Bruce (1932).

Access to the map-area is provided by Highways 539A and 805 from River Valley or by a gravel road from Riviere Veuve. Janes Township and the eastern half of McNish Township can be reached by canoe via the Sturgeon River. Ozhway Lake, located in this sector of the area, is accessible by float-equipped aircraft.

MINERAL EXPLORATION[2]

Exploration has been carried out for copper, nickel, lead, zinc, uranium and gold at a number of localities in the map-area.

Numerous companies and individuals explored the map-area for copper and nickel. In 1965 Pan Central Explorations Limited conducted a magnetometer survey and diamond-drilled five holes totalling 292 m (958 feet) north of Sargesson Lake in Janes Township. In 1968 Questor Surveys Limited performed a combined airborne magnetic and electromagnetic survey for Kennco Explorations (Canada) Limited over an area of approximately 673 km^2

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[1] Geologist, Precambrian Geology Section, Geological Branch, Ontario Division of Mines, Parliament Buildings, Toronto.

[2] Information from Assessment Work Files, Assessment Files Research Office, Division of Mines, Toronto, and Resident Geologist's Files, Sudbury.

(260 square miles) including Janes, McNish and neighbouring townships. As a result of this work and a geological survey, efforts were concentrated on an area west of Chiniguchi River where minor Cu-Ni mineralization is located and where the company diamond drilled 12 holes totalling 3070 m (10,074 feet). Kirkland Townsite Gold Mines Limited conducted an electromagnetic survey in west-central Janes Township in 1968. In the same year Triller Explorations Limited carried out a magnetometer survey west of Sargesson Lake and excavated a 9 m (30 feet) deep shaft. In 1969 Ossington Exploration Limited conducted electromagnetic and magnetometer surveys and diamond drilled seven holes for 615 m (2,017 feet) near the mouth of the Chiniguchi River where it meets the Sturgeon River.

Copper, lead, zinc and minor gold and silver mineralization occurs in northwestern McNish Township. Exploration work in this part of the map-area consisted of sporadic stripping and rock-pitting between the early 1930s and 1944. In 1956, Palston Mining and Development Company Limited conducted an electromagnetic and a gravity survey. Two holes totalling 24 m (80 feet) were diamond drilled and eight mineralized showings were pitted by blasting. In 1971, A.E. Jerome discovered copper sulphide mineralization on the west bank of Sturgeon River and in 1972 Jerome Explorations Limited carried out a geological mapping program and electromagnetic and magnetic surveys. Trenching and sampling was done on old and new showings and 24 short holes totalling 646 m (2,121 feet) were diamond drilled.

Exploration by local prospectors for uranium has been and is presently carried out in eastern McNish and Janes Townships. During the 1976 field season, a weakly radioactive showing was discovered in addition to the one shown on ODM map P.844 (River Valley, Lumbers 1973). The showing lies just outside McNish Township in western Pardo Township.

Exploration for gold in quartz veins has been carried out without success at a number of localities within the map-area. In 1962 H.F. Wiemer diamond drilled three holes for 96 m (316 feet) on his gold-quartz property in southern Janes Township.

GENERAL GEOLOGY

The map-area is located at the boundary of the Grenville Structural Province and Southern Structural Province of the Canadian Shield (Stockwell 1964). The Grenville Front Boundary Fault (Lumbers 1975) crosses Janes Township near the south boundary.

North of the Grenville Front, i.e. in the Southern Province, the rocks are mostly Middle Precambrian, a few are Early Precambrian and a single dike is Late Precambrian in age. The Early Precambrian rocks are metagreywacke, minor quartzite and mafic metavolcanics and are exposed in northwestern and northeastern McNish Township. Middle Precambrian sedimentary rocks of the Huronian Supergroup unconformably overlie the older rocks. The Mississagi and Gowganda Formations are the only Huronian rocks that outcrop in the map-area. The Mississagi Formation rocks are polymictic conglomerate, arkose, subarkose, quartz-sandstone and minor greywacke and argillite. The Gowganda Formation consists of greywacke, conglomerate and minor quartz-sandstone and arkose. The rocks of the Huronian Supergroup are intruded by Nipissing-type gabbro and by granitic and syenitic rocks. A Late Precambrian olivine diabase dike outcrops in northwestern Janes Township.

South of the Grenville Front Boundary Fault, i.e. in the Grenville Structural Province, the rocks consist of biotite-plagioclase gneiss, hornblende gneiss, amphibolite, anorthositic gabbro, gabbroic anorthosite, migmatite and massive pegmatite.

Hydrothermal quartz veins of unknown age intrude the Early Precambrian and Middle Precambrian rocks of northwestern McNish Township and the Middle Precambrian rocks at the Grenville Front.

The Precambrian bedrock is partly covered by unconsolidated Pleistocene glacial and fluvioglacial deposits.

STRUCTURAL GEOLOGY

The Early Precambrian rocks exhibit a WNW-striking and steeply dipping schistosity.

In McNish Township the Middle Precambrian rocks, i.e. the rocks of the Huronian Supergroup and the Nipissing-type gabbro are weakly deformed. The degree of deformation of these rocks increases from southern McNish and northern Janes Township towards southern Janes Township. In southern McNish and northern Janes Township the rocks commonly exhibit narrowly spaced cleavage fractures. Near the Grenville Front, i.e. 2 to 3 km north of the Boundary Fault, the rocks are schistose and folded. The schistosity commonly is parallel to the east-striking Front. South of the Grenville Front Boundary Fault, the gneisses in general also strike east, however, large scale and small scale structures are suggestive of a Late Precambrian, polyphase deformation.

Faults and lineaments are numerous within the area. The Grenville Front Boundary Fault crosses southern Janes Township in the Kabikotitwia River-Sturgeon River Valley. A NNE-striking fault along the Sturgeon River in northern Janes Township offsets a Late Precambrian olivine diabase dike for about 0.5 km (0.3 miles).

ECONOMIC GEOLOGY

Syngenetic *nickel* and *copper* sulphide minerals have been found in many places in Nipissing-type gabbro. Only disseminated mineralization consisting of pyrite, chalcopyrite and pyrrhotite have been observed and the best assays, obtained from showings north of Sargesson Lake, in Janes Township are 0.8 percent for copper and 0.74 percent for nickel, with the best combined percentage being 1.08 percent (Pan Central Explorations Limited, 1965, assays from Assessment Files Research Office, Ontario Division of Mines, Toronto).

Numerous showings of hydrothermal *copper-lead-zinc* mineralization occur in an 1.6 by 2.4 km (1 by 1.5 miles) area in the northwestern part of McNish Township. The mineralization is predominantly in quartz veins and silicified zones within the Gowganda Formation and Early Precambrian metasediments and metavolcanics. However, in a few places, pyrite and minor chalcopyrite was also observed finely disseminated in the country rock, and these disseminations were probably the source of the mineralization in the quartz vein. The age of the hydrothermal remobilization is not known. The mineralization within the quartz veins and in the silicified rocks consist of stringers, blebs and disseminations of chalcopyrite, pyrite, sphalerite and galena. A sample analyzed in 1971 by Jerome Explorations Limited assayed 0.45 percent copper, 1.60 percent lead and 7.57 percent zinc. Other samples assayed up to 0.10 ounces gold per ton and 2.70 ounces silver per ton (assays from Assessment Files Research Office, Ontario Division of Mines, Toronto).

Uranium in the area occurs in a radioactive quartz-pebble conglomerate of the Mississagi Formation similar in appearance to the uraniferous conglomerate near Tee Lake in Pardo Township (Thomson 1960). The mineralized showing is in eastern McNish Township (Lumbers 1973). During the 1976 field season a weakly radioactive (2 times background, 150-200 c.p.m.) pyrite-bearing and rusty weathering Mississagi quartz-sandstone was found by the author in Pardo Township just east of McNish Township.

Some quartz veins have been found in southwestern and eastern Janes Township where considerable exploration for *gold* has been carried out. These quartz veins in places contain minor amounts of pyrite and chalcopyrite.

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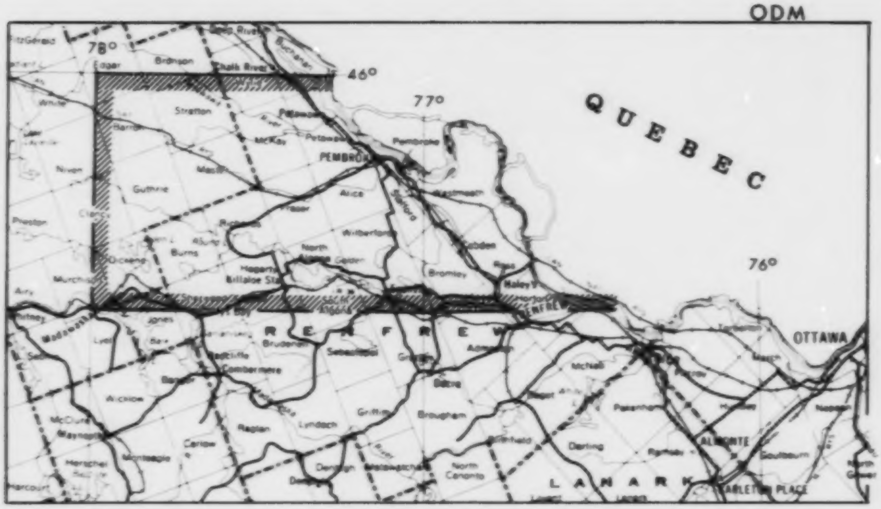
NO. 22 PEMBROKE AREA, DISTRICT OF NIPISSING AND COUNTY OF RENFREW

S.B. Lumbers[1]


ODM
78°
46°
77°
76°
QUEBEC
PEMBROKE
Pembroke
Petawawa
McKay
Stratton
Edgar
Bronson
Chalk River
Buchanan
Guthrie
Clancy
Niven
Preston
Murchison
Burns
Algona
North Algona
Alice
Fraser
Wilberforce
Stafford
Bromley
Ross
Haley
Horton
Hagarty
Killaloe Sta.
Jones
Lyell
Madawaska
RENFREW
Brudenell
Sebastopol
Grattan
Admaston
Radcliffe
Combermere
Raglan
Lyndoch
Griffith
Brougham
Bagot
McNab
Carlow
Wicklow
Maynooth
McClure
Monteagle
Herschel
Harcourt
North Canonto
Darling
Pakenham
Ramsay
Goulbourn
ALMONTE
CARLETON PLACE
Torbolton
March
OTTAWA
LANARK

LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

LOCATION

The Pembroke area covers about 5,000 km^2 (2,000 square miles) and is bounded by Longitude 78°00'W and the Ottawa River, and by Latitudes 46°00'N and 45°30'N. The eastern part of Algonquin Provincial Park, Canadian Forces Base Petawawa, and the Towns of Petawawa, Pembroke, Eganville, Killaloe, and Madawaska are included in the area. One inch to 1 mile (1:63,360) reconnaissance mapping of the area, which commenced in 1975 (Lumbers 1975), was continued during the 1976 field season, and geological data has now been gathered from the entire region. This data is sufficient to indicate the main geological units present, but further work will be required to fully define their distribution and relationships.

MINERAL EXPLORATION

A large variety of mineral deposits have been explored and mined in the Pembroke area over the past 100 years. The main deposits known are apatite, asbestos, clay, feldspar, fluorite, graphite, iron, magnesium, marl, mica, molybdenum, peat, pyrite, rare earth minerals, stone, uranium, and sand and gravel. Minor copper mineralization, chiefly in the form of sparsely disseminated chalcopyrite, is present in places, particularly in association with metavolcanics and mafic intrusions in the southeastern part of the area. The only production attained has been from deposits of clay (for production of brick and tile), feldspar, mica, magnesium, stone (mainly for lime and aggregate), and sand and gravel. Present production is confined to stone and sand and gravel used for local construction purposes, and to magnesium produced from dolomitic marble in Ross Township by Chromasco Limited.

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[1] Curator of Geology, Royal Ontario Museum.

GENERAL GEOLOGY

Most of the Pembroke area is underlain by rocks of the Grenville Province of the Canadian Precambrian Shield. Several outliers of Ordovician limestone and minor associated shale and sandstone unconformably overlie the Precambrian rocks in the eastern part of the area. These outliers are associated with major faults of the Ottawa-Bonnechere Graben that extends across the eastern and northern parts of the area and westward into the Mattawa-Deep River area (Lumbers 1976).

Rock exposures throughout the map-area ranges from poor to excellent, and in general, bedrock is best exposed in the central and northwestern parts. Elsewhere, extensive Quaternary deposits cover much of the bedrock, but isolated zones of excellent exposure are present, particularly in the southeastern quarter of the area.

As discussed previously, (Lumbers 1975), the area straddles the boundary between Middle and Late Precambrian supracrustal sequences in the Grenville Province. The Middle Precambrian supracrustal rocks, the oldest rocks exposed in the map-area, are mainly coarsely recrystallized derivatives of moderately to well sorted sandstones containing numerous intercalated units of shale, siltstone, and calcareous sandstone; marble is rare. These rocks extend southward from the Mattawa-Deep River area (Lumbers 1976) into the northern part of the Pembroke area where they were intruded by a large batholith of Middle Precambrian age (Lumbers 1975). They are exposed along the northern margin of the batholith in Edgar, Barron, Stratton, Wylie, Buchanan, McKay, and Petawawa Townships, and along the southeastern margin in Sherwood, Hagarty, and Richards Townships. Elsewhere, they are exposed only as xenoliths within the batholith, which dominates all but the southeastern third of the area and extends for unknown distances to the west and southwest of the area; the eastern margin of the batholith is covered either by younger rocks, or by Quaternary sediments. The batholith consists of gneissic anorthosite-suite rocks with quartz monzonite and syenite predominating, but gabbroic, anorthositic and tonalitic phases are locally abundant within the batholith in the western part of the area.

The Middle Precambrian metasediments and the batholith are overlain unconformably by a unit rich in medium- to coarse-grained arkosic metasandstone which forms the basal section of the Late Precambrian supracrustal sequence. This unit trends northeastward from southeastern Hagarty Township through northern North Algona, northwestern Wilberforce, southeastern Alice, and northern Stafford Townships towards Ottawa River where it is largely covered by Quaternary sediments. The unit locally contains intercalated, gneissic, orthoquartzite and siliceous marble beds up to 1 m (3 feet) thick and shows a facies change upward into marble and calc-silicate metasediments. The actual unconformity was observed in a few places against rocks of the batholith, and at these places, gneissic, coarse-grained arkose rests upon the gneissic igneous rocks of the batholith. Outliers of the unit resting upon rocks of the batholith are also present beyond the main contact of the unit, particularly in the vicinity of Petawawa and Barron Rivers in Stratton and McKay Townships, and in Jones, North Algona, and Wilberforce Townships.

Most of the Late Precambrian supracrustal sequence southeast of the basal arkosic unit consists of marble, calc-silicate metasediments, and local units of intercalated silty, shaly, and calcareous metasediment containing numerous beds of quartz-rich metasandstone. In Admaston, Ross, and Horton Townships, mafic and minor felsic metavolcanic units are present in the carbonate-rich supracrustal sequence. Units of metagreywacke and locally cherty dolomitic marble are associated spatially with the metavolcanics.

A large variety of intrusive rocks were emplaced within the Late Precambrian supracrustal sequence, mainly before the culmination of regional metamorphism. The oldest intrusions are: 1) metagabbro sills and dikes; 2) trondhjemite and granodiorite stocks associated with metavolcanics; 3) anorthosite suite intrusions consisting mainly of gneissic syenitic, anorthositic, and tonalitic rocks; and 4) gneissic quartz monzonite and syenite bodies characterized by numerous pegmatitic fluorite-apatite-calcite dikes. The gneissic quartz monzonite and syenite bodies are lithologically complex with numerous xenoliths of marble, skarn, and calc-silicate rocks; much of the syenite is pegmatitic and contains coarse crystals and aggregates of amphibole, altered pyroxene, and apatite up to several centimetres in size. In addition to these early gneissic intrusions, there is a small stock of syenite and minor quartz monzonite in South Algona Township and an irregularly shaped body of gabbro and minor granodiorite in Horton and Ross Townships. Both of these intrusions are only partly metamorphosed and were emplaced apparently during the waning stages of regional metamorphism.

Late Precambrian regional metamorphism that caused the rocks described above to be coarsely recrystallized and deformed into gneisses was accomplished under the temperature and pressure conditions of the middle and upper almandine amphibolite facies according to mineral assemblages developed in the various gneisses. When the metamorphism was on the wane, granite pegmatite dikes were emplaced throughout the supracrustal and intrusive rocks; syenite pegmatite dikes characterized by accessory pyroxene and dark red alteration due to hematitization are found locally in the Late Precambrian supracrustal rocks. Following emplacement of the pegmatite dikes, diabase dikes were intruded along and close to WNW-trending fault zones that are related to the Ottawa-Bonnechere Graben (Lumbers 1975).

STRUCTURAL GEOLOGY

Some of the main structural features of the map-area were outlined previously (Lumbers 1975). Preliminary analysis of data collected in the 1976 field season suggests that during the Late Precambrian regional metamorphism, the large batholith underlying all but the southeastern third of the area rose as a diapir into the Late Precambrian supracrustal sequence. This diapirism could account for the predominance of flat to gently dipping foliation common in most of the rocks of the batholith and in the surrounding supracrustal rocks. Because mapping is incomplete, structural data concerning the Late Precambrian supracrustal rocks and intrusions in the southeastern part of the area permits only a few brief generalizations. For the most part, foliation dips gently eastward, and several folds can be mapped in the supracrustal rocks with axes trending northward to northwestward. Silty and sandy metasediments intercalated with marble are invariably dismembered, forming spectacular tectonic breccias, both on outcrop and larger scales. Most likely, these supracrustal rocks underwent polyphase deformation, but an adequate appreciation of their structural complexity must await further mapping.

ECONOMIC GEOLOGY

A few general mineralization patterns revealed by work in the area during 1975 were summarized previously (Lumbers 1975). Additional mapping carried on in 1976 shows that most of the fluorite and apatite mineralization present in the area (see Satterly 1944) is associated with the gneissic quartz monzonite and syenite bodies in the Late Precambrian supracrustal sequence. This mineralization is present in late calcite-rich dikes and pegmatitic syenite phases of the bodies. Most of the apatite occurs as coarse crystals up to 25 cm (10 inches) long in the calcite dikes, but massive aggregates and crystals no more than 10 cm in size are also present in pegmatitic syenite. Most of the fluorite is intergrown with calcite in the calcite dikes which also contain coarse crystals and aggregates of alkalic feldspar and scapolite. Both fluorite and apatite are also present in skarn and calc-silicate marble near the margins of the bodies; minor disseminated pyrite, pyrrhotite, and chalcopyrite, and rare massive aggregates of sphene accompany the fluorite and apatite mineralization in this rock type. The fluorite-apatite-calcite dikes are locally concentrated in some of the bodies, and this suggests that the bodies may prove worthy of exploration as a possible source of phosphate and lime.

Irregularly shaped gossan zones were noted near the contact between mafic metavolcanics and a small stock of trondhjemite and granodiorite in Ross Township, about 5 km (3 miles) ENE of the village of Forester Falls. Small gossan zones also occur in the late gabbroic intrusion in Ross and Horton Townships, and new road construction has opened a few of these zones revealing disseminated chalcopyrite, pyrrhotite and rare pentlandite mineralization in mafic-rich gabbro and altered pyroxenite. Mapping of this intrusion is incomplete, so that the extent of this mineralization is unknown.

Several late syenite and granite pegmatite dikes were examined with a geiger counter for radioactivity, but no concentrations of radioactive minerals were found. Only a few dikes (mainly the syenitic variety) gave readings slightly above normal for the area. No abnormal radioactivity was detected in the gneissic quartz monzonite and syenite bodies containing fluorite-apatite-calcite dikes. Airborne gamma-ray spectrometry data released in June, 1976 (GSC 1976) shows only one small anomaly in the map-area that straddles Ottawa River in northeastern Ross Township. Abundant rock exposure is present in the vicinity of the anomaly (mainly marble containing a few thin units of mafic metavolcanics), but no radioactive mineralization was detected by the author. As pointed out previously (Lumbers 1975), the presence in the area of an unconformity marked by a basal arkosic unit that separates Middle and Late Precambrian supracrustal sequences suggests a favourable geological environment for uranium mineralization. Unfortunately, the airborne gamma-ray spectrometry survey flown at a spacing of 5 km (3 miles) was done before completion of the geological mapping, so that the unconformity was not examined in sufficient detail by the survey. Basic geological data is a prerequisite to a meaningful assessment of the uranium potential of the area, and consequently, such an assessment must await the completion of the present study.

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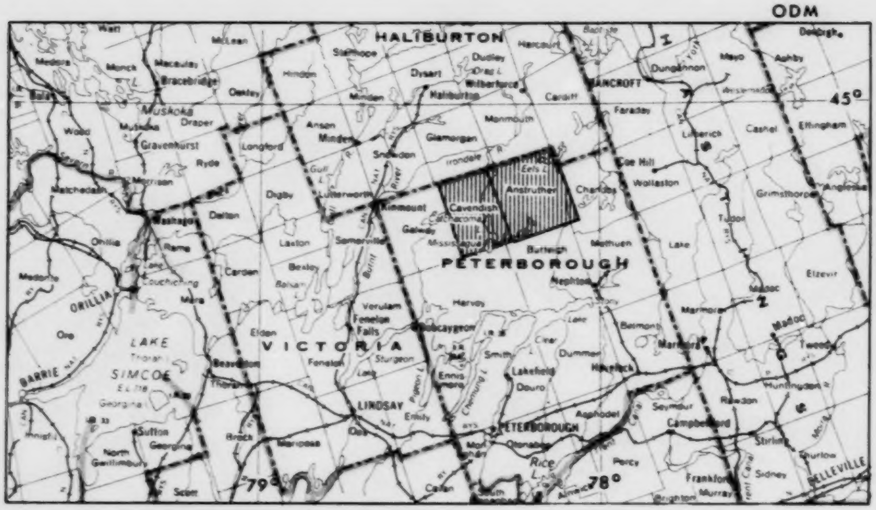
NO. 23 CAVENDISH AND ANSTRUTHER TOWNSHIPS

PETERBOROUGH COUNTY

E.G. Bright[1]



LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

INTRODUCTION

A program of semi-detailed mapping of the Cavendish-Anstruther area, southwest of Bancroft commenced in the 1975 field season and continued through the 1976 season. The major aims of this program are: (1) to outline major rock stratigraphic units and regional structures; and (2) to obtain an understanding of the geological setting of the Bancroft area uranium deposits which will provide guidelines for future exploration. An important clue to the origin of the uranium in the Bancroft area, resulting from the work to date is the recognition of a stratigraphic control on the distribution of most of the uranium.

LOCATION

Cavendish and Anstruther Townships, an area of approximately 620 km^2 (240 square miles) are located about 40 km (25 miles) southwest of Bancroft. Primary access is by Highway 28, north from Peterborough or via Highway 36 and 507 from Lindsay. During the 1976 field season, most of Anstruther Township was mapped at a scale of 1 inch to ¼ mile; local areas in northern Anstruther and southern Cavendish Townships were mapped or remapped to augment the 1975 coverage.

MINERAL EXPLORATION

Exploration for base metals, iron, and industrial minerals has been carried out at a number of localities within the area. Since the early 1950s most of the exploration has been concentrated in and near the more than 20 known uranium prospects. Major features of the exploration history in the area were described previously (Bright 1974; 1975). During the 1975-1976 field season, Kerr Addison Mines Limited, Imperial Oil Limited, and The International Nickel Company of Canada Limited carried out work programs on their respective uranium holdings.

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GENERAL GEOLOGY AND STRUCTURE

The geology of the Cavendish-Anstruther area is dominated by a large oval-shaped, mantled gneiss dome termed the Middle Precambrian Burleigh-Anstruther Basement Gneiss Complex. Late Precambrian, isoclinally folded metasediments and metavolcanics of the Grenville Supergroup (Wynne-Edwards 1972) unconformably mantle the basement gneiss complex on all sides of the Anstruther dome.

The Burleigh-Anstruther Basement Gneiss Complex consists mainly of interlayered, grey migmatitic biotite-rich quartz plagioclase gneiss and pinkish to pinkish grey migmatitic biotite-quartz-plagioclase gneiss. These thin to thickly banded gneisses are considered by the author to be clastic metasediments, probably Middle Precambrian feldspathic wackes. Structurally, the basement gneiss dome comprises two major coalesced anticlinal fold core centers. Steeply dipping migmatitic biotite gneiss occupies the narrow synclinal areas between the more intensely flattened gneisses in the fold core regions. Regionally the banding and the foliation of the basement gneisses along the margins of the dome are concordant with the pronounced stratiform foliation in the mantling rocks of the Grenville Supergroup. The basement-cover contact itself is a broad zone of anatexis, migmatization and local infolding of basement and cover rocks. The rocks of the basement complex were deformed at least once prior to the deposition of the Grenville Supergroup.

The metasediments and metavolcanics of the Grenville Supergroup, together with associated subordinate mafic to felsic intrusions were subjected to Late Precambrian deformation and metamorphism under conditions ranging from middle to upper amphibolite facies rank. Felsic plutonic rocks of several ages were emplaced at successive stages, before, during and after culmination of this high rank metamorphism (Bright 1975). During the waning stages of regional metamorphism and deformation, granite pegmatite and pegmatitic granite sills (locally dikes) were intruded throughout the entire sequence of metamorphosed Late Precambrian supracrustal rocks that mantle the Anstruther dome. These late stage pegmatitic sills, except for a few localities along the basement-cover contact zone do not intrude the main basement gneiss complex.

The entire metamorphic complex, including the late stage pegmatites (some uranium-bearing) are fractured and offset by regional northeast-striking thrust faults, and north- to northeast-striking normal faults.

Grenville Supergroup Stratigraphy

The map-area lies within the central Metasedimentary Belt subdivision of the Grenville Province (Wynne-Edwards 1972), and straddles the proposed boundary between two smaller tectonic subdivisions: the Hastings Basin segment and the Glamorgan-Cardiff Arch segment. Stratigraphic studies of the Grenville Supergroup in the Hastings Basin segment by Lumbers (1967) have distinguished an older Hermon Group, mainly metavolcanics, and a younger Mayo Group, mainly marbles.

The rocks of the Grenville Supergroup in the Glamorgan-Cardiff Arch segment have been correlated over most of Cavendish and Anstruther Townships as well as the southern parts of Glamorgan, Monmouth, Cardiff and Faraday Townships; the townships immediately north of the map-area. The metasediments and previously unreported metavolcanics (Bright 1975) have been assigned to the Hermon and Mayo Groups as well as a proposed new Group, the Anstruther Lake Group which underlies the Hermon Group in the map-area. The proposed Anstruther Lake Group has not been reported in the main Hastings Basin segment. In the map-area the Grenville Supergroup comprises, in ascending order, the Anstruther Lake Group, the Hermon Group and the Mayo Group. The stratigraphic succession is shown in Table 1 and the various sub-units are subsequently described in terms of their present and inferred pre-metamorphic lithology.

ANSTRUTHER LAKE GROUP

The Anstruther Lake Group consists mainly of quartzofeldspathic paragneiss and unconformably overlies the basement gneiss complex. The group has an estimated maximum thickness of about 1500 m (5,000 feet) and has been

TABLE 1 TENTATIVE STRATIGRAPHIC SUCCESSION OF THE GRENVILLE SUPERGROUP IN THE CAVENDISH-ANSTRUTHER TOWNSHIPS AREA.

GROUP (top of sequence)	FORMATION	
	CAVENDISH TOWNSHIP	ANSTRUTHER TOWNSHIP
MAYO		Apsley
	Dungannon	Dungannon
HERMON	Eels Lake	Eels Lake
	Cavendish	
		Glanricarde
	Mississagau	
		Monmouth Marble
ANSTRUTHER LAKE	Upper sub-unit Lower sub-unit	Upper sub-unit Lower sub-unit

subdivided into: a *Lower formation* — mainly arkose and arkosic arenite, subordinate ferruginous arenite, feldspathic arenite (now quartzofeldspathic gneisses); and an *Upper formation* — mainly thinly interbedded feldspathic wacke and feldspathic arenite, subordinate calcareous wacke (now biotite-rich and biotite-poor quartzofeldspathic gneiss, subordinate calc-silicate gneiss).

HERMON GROUP

The Hermon Group concordantly overlies the Anstruther Lake Group and has an estimated maximum thickness of about 2700 m (9,000 feet). Volcanic rocks predominate, but are most abundant in southwest Cavendish Township, up to 1500 m (5,000 feet) thick, and in northeast Anstruther Township, up to 900 m (3,000 feet) thick. The stratigraphic successions within the group differ in various parts of the map-area. In Anstruther Township, the Hermon Group comprises, in ascending order, the Monmouth marble, the Glanricarde formation and the Eels Lake formation; in Cavendish Township, the Mississagua formation, the Cavendish formation and the Eels Lake formation. These proposed new formational subdivisions of the Hermon Group in the map-area are described below.

The *Monmouth marble*[1] consists mainly of dolostone and limestone with subordinate calcareous wacke at the base and top of the formation (now silicated marble, subordinate biotite gneiss and calc-silicate gneiss). The *Glanricarde formation*[1] consists mainly of arkosic metasediments probably formed from locally derived volcanic debris, but may in part contain primary tuffaceous units (now quartzofeldspathic gneiss and aluminous feldspathic gneiss). Subordinate feldspathic and calcareous wacke are present near the top of sequence (now biotite-rich feldspathic gneiss and calc-silicate gneiss). In Cavendish Township, this unit is equivalent to the Mississagua formation. The *Mississagua formation*[1] consists of interbedded feldspathic arenite and feldspathic wacke with subordinate calcareous wacke and mafic to intermediate tuff (now biotite- and hornblende-biotite-bearing quartzofeldspathic gneiss; subordinate calc-silicate gneiss and amphibolite). The *Cavendish formation*[1] consists mainly of metamorphosed basaltic and andesitic flows and tuff (now layered and foliated amphibolite, calc-silicate gneiss and aluminous schist and gneiss), with subordinate intermediate to felsic flows and pyroclastic rocks (now aluminous and non-aluminous quartzofeldspathic gneiss and schist), and minor marble and arkosic gneiss. The *Eels Lake formation*[1] in Anstruther Township has a *Lower Volcanic member* which may be equivalent in part to the Cavendish formation. This *Lower Volcanic member* mainly consists of foliated and layered basaltic and andesitic flows and tuff (now amphibolite, calc-silicate gneiss and aluminous gneiss); with minor marbles and feldspathic wackes. The *Upper Clastic member* is strikingly similar throughout the map-area. It consists of thinly interbedded calcareous wacke, mafic to intermediate tuff and feldspathic wacke (now calc-silicate gneiss, amphibolite and aluminous gneiss and schist).

MAYO GROUP

The Mayo Group concordantly overlies the Hermon Group (locally the contact is gradational). It has a maximum thickness of about 1500 m (5,000 feet) and comprises, in ascending order, the Dungannon and Apsley Formations. The *Dungannon Formation* (Hewitt and James 1955) consists mainly of dolostone and limestone (marbles); minor feldspathic arenite and wacke and recrystallized chert. Thin interbedded units of mafic tuff (amphibolite) and impure marble, termed the *Detlor member* by Hewitt and James (1955) occur near the base of the formation. The *Apsley Formation* (Shaw 1962) comprises thinly interbedded feldspathic arenites and wackes with subordinate ferruginous and argillaceous metasandstones (now biotite-rich and biotite-poor quartzofeldspathic gneiss).

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[1] Proposed new stratigraphic subdivision in the Hermon Group.

ECONOMIC GEOLOGY

The exploration potential for: (1) stratabound sulphide deposits in the metavolcanics; (2) stratabound iron-oxide and iron-sulphide deposits in marble; and (3) nickel-copper sulphide deposits in mafic intrusive rocks was previously outlined in last years summary (Bright 1975). The most significant fact resulting from the present investigations is the recognition of a stratigraphic control on the distribution of uranium deposits.

Uranium Mineralization

With the exception of a few minor occurrences, all known uranium deposits occur in the metasediments and metavolcanics of the Hermon Group, particularly the Eels Lake and Cavendish formations. A total of 24 uranium occurrences in the map-area have been previously documented by Satterly (1956) and Bright (1974; 1975). Field investigations which are still in progress have provided good evidence for the correlations of the Eels Lake formation and its equivalents with the host rocks to many of the uranium deposits near Bancroft, just to the north of the present map-area. These deposits include the Canadian Dyno, Halo, and Bicroft deposits in Cardiff Township, the Rare Earth deposits in Monmouth Township and the Faraday and Greyhawk deposits in Faraday Township.

The uranium mineralization, principally uraninite and uranothorite occurs mainly as irregular disseminations or fracture-vein fillings within or immediately adjacent to the contact with late tectonic pegmatitic granite sills (or dikes) intruding the Hermon Group. The uranium-bearing pegmatitic intrusions (locally syenitic) commonly exhibit contaminated border zones containing partially assimilated screens or inclusions of calc-silicate gneiss, amphibolite and aluminous paragneiss or schist. Associated with this wall rock assimilation and in many places uranium mineralization is: (1) a red discoloration (hematization) of the feldspar and quartz in the pegmatitic granite; (2) the secondary development of hornblende and pyroxene phenocrysts and smokey quartz aggregates in the pegmatitic granite; and (3) the late development of magnetite, iron sulphides, tourmaline and fluorite-calcite either as disseminations or fracture-vein fillings in the pegmatite proper or in the adjacent calc-silicate wall rock.

An important fact to note when exploring for radioactive pegmatite zones is that these late stage pegmatitic granite sills are equally abundant in the Anstruther Lake Group and the lower Mayo Group, but to date no important uranium mineralization has been found in either sedimentary group. Field evidence indicates that the late tectonic pegmatitic granite sills and dikes were formed by *in situ* anatexis and remobilization of the basal arkosic metasediments of the Anstruther Lake Group. All gradations from non-granitized arkosic metasediments to anatectic pegmatitic granite were mapped widely along the basement-cover contact zone. Although a few small occurrences of uranium mineralization have been found in the granitized arkosic units near the unconformity of the Grenville Supergroup and the basement gneiss, field evidence indicates that the bulk of the uranium was derived from the rocks of the Hermon Group.

The volcanic rocks and associated volcanoclastic sediments of the Hermon Group are of special significance because they may represent the primary igneous source of uranium which, on mobilization, could have contributed to the localization of pre-metamorphic supergene concentrations of uranium in the sedimentary basin. The emplacement of the pegmatitic granites together with wall rock assimilation and metasomatism of the Hermon Group were ultimately responsible for the final remobilization, concentration and deposition of the uranium. Future exploration programs for uranium within or adjacent to the Cavendish-Anstruther area should therefore concentrate on those pegmatitic sills and dike swarms cutting the intercalated calc-silicate gneiss, amphibolite, and aluminous gneiss (plus minor marble) sequences of the Hermon Group.

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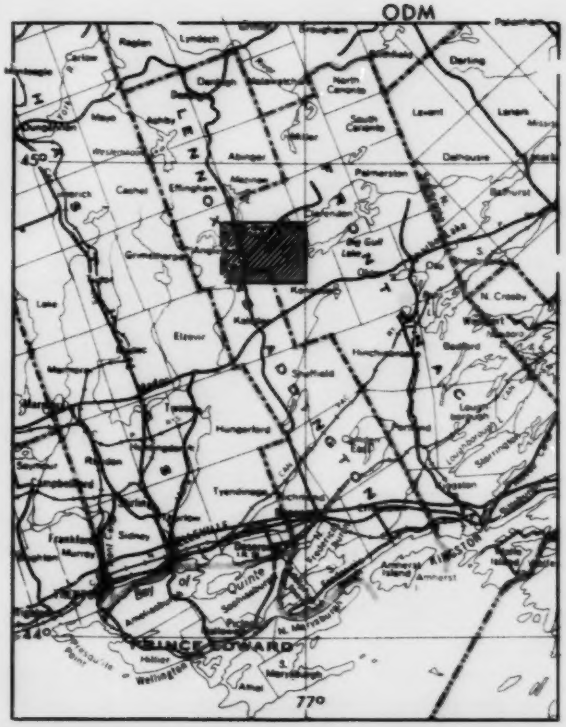
NO. 24 CLARENDON LAKE AREA, COUNTIES OF FRONTENAC AND LENNOX AND ADDINGTON

J.M. Moore[1]


ODM
45°
44°
77°
Bay of Quinte
PRINCE EDWARD
KINGSTON
Amherst
Wellington
Sidney
Murray
Hungerford
Tyendinaga
Elzevir
Sheffield
Kaladar
Barrie
Abinger
Clarendon
Palmerston
Dalhousie
Bathurst
Bedford
Loughborough
Storrington
N. Crosby
Sophiasburgh
Ameliasburgh
Hillier
Athol
N. Marysburgh
S. Marysburgh
Pittsburgh
Camden
Portland
Kennebec
Grimsthorpe
Madoc
Lake
Cashel
Effingham
Anglesea
Denbigh
Ashby
Mayo
Wollaston
Limerick
Dungannon
Raglan
Lyndoch
Brudenell
Griffith
Bagot
Darling
Lavant
Lanark
North Canonto
South Canonto
Miller
Rawdon
Seymour
Frankford
Huntingdon
Marmora

LOCATION MAP

Scale: 1:1,584,000
or 1 inch to 25 miles

INTRODUCTION

The map-area lies in the Grenville Province, 120 km (75 miles) southwest of Ottawa, and is bounded by Latitudes 44°45′ to 44°52.5′N and Longitudes 77°00′ to 77°15′W. There is good road and lake access to most of the area. Approximately two-thirds were mapped during the field season; the remainder of the geology has been compiled from earlier, unpublished data of Moore and from graduate theses at Carleton University, Ottawa.

MINERAL EXPLORATION

The area was extensively prospected for gold from the late 19th Century to the 1930s. Two mines, the Star of the East (Corkhill 1907; Hopkins 1921) and the Ore Chimney (Miller and Knight 1913; Shklanka 1969, p.132), were operative about 1907 and 1915 respectively, but only the Star is reported to have produced a small amount of gold (Tremblay 1940). During this period small occurrences of copper, zinc, lead, arsenic and tungsten were also verified. Recent prospecting activity has been restricted to brief visits by geologists of major companies, and local efforts by individuals and small syndicates. Last season, a small amount of pitting was performed on the Star property by A. Banner on chalcopyrite, gold and scheelite mineralization, and on a copper-zinc prospect. A factory in the area operated by W.J. Barnes Limited produces marble chips from material trucked from several small quarries.

GENERAL GEOLOGY

The stratified rocks of the area comprise four major units (listed in order of decreasing age):

A. Tudor metavolcanic group (continuous with the metavolcanic rocks mapped by Lumbers 1969, in Tudor Township).

B. Barrie marble group, conformably overlying the Tudor group, comprising dolomitic and calcitic marbles.

C. Plutonic group, consisting mainly of the Elzevir and Northbrook granodiorite batholiths, intrusive into the Tudor group, as well as smaller, more potassic plutons intruding both of the older groups.

D. Flinton Group (Moore and Thompson 1972; in preparation) a formally-defined, largely metaclastic succession, lying unconformably on all the preceding units.

Relative to published data of the Division, the most important advances in knowledge are the improved understanding of the stratigraphy of the Tudor group (including the recognition of siliceous metavolcanics formerly mapped as granitic gneisses) and the recognition of the Flinton Group as a distinct stratigraphic unit postdating major volcanism and plutonism.

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The Tudor group comprises a relatively uniform foundation of submarine, tholeiitic flows with subordinate intercalated volcanogenic sedimentary rocks, overlain by a more heterogeneous calc-alkaline succession, related to several centres, varying upward generally from andesite to dacite and rhyolite, and including flows, tuff-breccias, tuffs, volcaniclastic sedimentary rocks and intrusive breccias, small subvolcanic plutons, sills and dikes. Sulphide minerals are locally abundant in these centres, and several hitherto-unreported copper occurrences have been documented. Other base metal-gold occurrences are in carbonate rocks close to the top of the Tudor group.

The base of the Flinton Group is a major regional unconformity, mantled in the map-area by hematitic pelite, quartzite and metaconglomerate primarily composed of quartzite pebbles in a pelitic matrix. Several gold-base metal sulphide mineral occurrences in the map-area, and adjacent to it lie at the unconformity where the Flinton Group overlies rocks of the Tudor group.

All of the rock units have been deformed and recrystallized under conditions of the garnet and staurolite zones of regional metamorphism. Nonetheless, primary structures such as pillows, pyroclastic features, phenocrysts, crossbeds, grain gradation and load casts are locally well preserved. Although there is local warping and mineral growth predating, or associated with, plutonic intrusion, the major deformations and regional metamorphism postdate the Flinton Group and are related to the Grenvillian Orogeny. The Flinton Group occupies narrow, northeasterly trending isoclinal synclinoria (of the first regional deformation D_1) in the pre-Flinton units, with angular discordance at the base. In the central part of the map-area, this discordance has been accentuated by vertical extension. The Northbrook batholith lies in a D_2 antiform to the south of the map-area, and second-phase mineral fabrics are imposed locally on all the rock units. In much of the map-area there is a large angular discordance between stratigraphic boundaries in the pre-Flinton rocks and the regional Grenvillian trend of folds and units in the Flinton Group.

ECONOMIC GEOLOGY

Despite the lack of major base-metal prospecting to date, the Tudor group must be regarded as possessing significant potential for economic occurrences of copper, zinc and associated metals. Although the individual size of such deposits may not be expected to be large, and the prevalence of steep linear structures implies small geophysical and geochemical targets, the proximity of the area to good transport and markets warrants systematic, modern prospecting. Efforts should be concentrated initially on recognized intermediate-felsic volcanic centres demonstrating sulphide mineralization.

Gold occurrences appear to be related both to 1) igneous processes, perhaps in part to exhalative activity concurrent with carbonate deposition, and 2) sedimentary (?) and metamorphic concentration along the pre-Flinton unconformity. The contacts between Tudor and Barrie groups, and between pre-Flinton units and the Flinton Group, are well-documented targets worthy of exploration.

Zinc-lead, sulphide-sulphosalt mineralization occurs in the map-area at two localities in a thin dolomite marble of the Flinton Group, and at many other locations on strike to the northeast. The Mazinaw base metals occurrence is located about 5 km (3 miles) east of Myers Cave on Highway 506. Work was conducted about 1937, and a shallow pit marks the occurrence. The second occurrence, known as the International Mine, is located 6 km (4 miles) east of Myers Cave on Highway 506. Work was done on this occurrence about 1902-1903, at which time seven test pits and two shafts were excavated (Carter 1903). These mineral deposits are closely stratabound and associated with a transition from a shallow-water, oxidizing environment to a deeper, reducing environment of sedimentation widely recognized in the Flinton succession.

Although there are no reported occurrences of radioactivity in the area, the fact that the lower units of the Flinton Group are a "red bed" succession suggests some uranium potential. The paucity of unstable clastic material in the Flinton metasediments, as well as their high hematite content (up to 10 percent in some pelitic horizons) may be evidence of deep tropical weathering of the underlying terrain.

Greenstone, marble and plutonic rocks, although largely unexploited, are suitable for crushed stone and dimension stone applications.

Much of the dolomite marble is fine grained, with a variety of attractive shades. The homogeneity of the Elzevir and Northbrook granodiorites, and the Skootamatta quartz syenite suggests a potential for deep storage of noxious wastes. However, the present and potential value of the area for tourism and recreation is so high that any mining or related activity will of necessity be clean, of low visibility and carefully controlled.

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Phanerozoic Geology Section

PHANEROZOIC GEOLOGY SURVEYS, 1976

W.R. Cowan[1]

The Phanerozoic Geology Section is responsible for the survey and analysis of post-Precambrian rock and soil materials in Ontario. During the 1976 season seven field parties were active in northern and southern Ontario.

Mapping of Paleozoic rocks in the Cambridge-Simcoe and Woodstock-Grand Bend areas was carried out by P.G. Telford. In the Simcoe area the contact between the Dundee Formation and the underlying Onondaga Formation has been recognized for the first time. The limits between the Onondaga Formation and its laterally equivalent strata in the Detroit River Group have not yet been determined. Several new fossil localities were discovered within the Hungry Hollow and Widder Formations in the Parkhill area.

New findings and interpretations of interest to Quaternary geologists are summarized briefly here. In the Tillsonburg area, P.J. Barnett recognized end moraines, consisting of Port Stanley Till, east of the Tillsonburg Moraine. He also notes the presence of multiple units of Port Stanley Till. In the Seaforth-Goderich area, A.J. Cooper has found that sediments at the core of the Seaforth Moraine are continuous with those of the Wawanosh Moraine. He has also identified five or more till units within the Strathroy map-area. At Sault Ste. Marie the writer found evidence to suggest that a sizeable arm of Main Lake Algonquin existed in the eastern Lake Superior basin. Organic sediments reported in 1863 near Goulais Bay have been dated at about 6500 radiocarbon years before present. In the Chesley area D.R. Sharpe has identified two tills younger than a till unit described as a continuum of Elma and Catfish Creek Tills. The Tara Moraines (Strands) formed as ice-marginal deltas.

Inventory of granular mineral aggregates is continuing at an enhanced pace. Resource reports for several townships in the Grey-Bruce-Huron Counties area were prepared by E.V. Sado and J.Z. Fraser for a Mineral Aggregate Study on the Southwestern Region by the Proctor and Redfern Group Limited. Reports containing recommendations for extractive area zoning were prepared for several townships and the Phanerozoic Section is now preparing these for all townships designated under the Pits and Quarries Control Act 1971. E.V. Sado carried out a reconnaissance study of granular aggregates in the Kenora, Fort Frances, Red Lake area.

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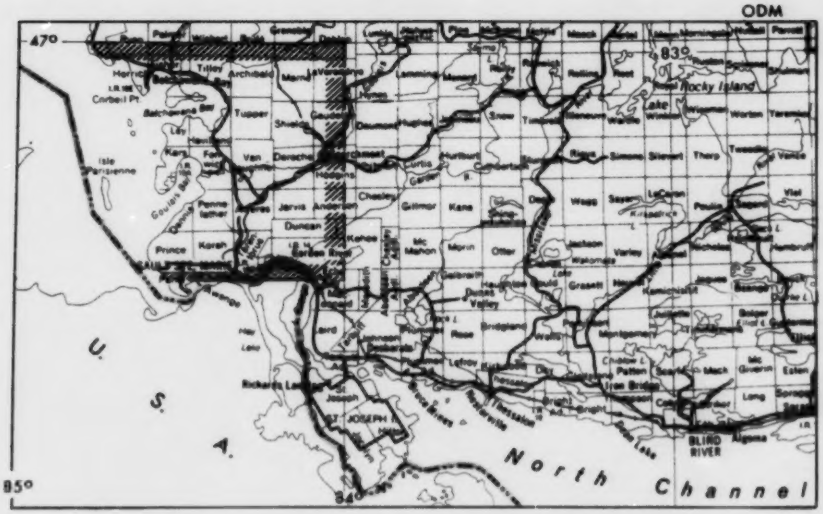
Research results into the "Mineralogy and Physico-chemistry of Leda clays from deep boreholes, Hawkesbury, Ontario" was reported to the section by J.E. Haynes and R.M. Quigley of the University of Western Ontario and was released as OFR 5214.

NO. 25 QUATERNARY GEOLOGY OF THE SAULT STE. MARIE AREA

DISTRICT OF ALGOMA

W.R. Cowan[1]



LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

LOCATION

The City of Sault Ste. Marie (Sault Ste. Marie 41K/9c and Leigh Bay 41K/9d NTS sheets) was mapped for publication at a scale of 1:25,000, and the surrounding area, bounded by Latitudes 46°30′ and 47°00′N and Longitudes 84°00′ and 85°00′W (Sault Ste. Marie, 41K/9; Isle Parisienne, 41K/10; Searchmont, 41K/16; and Pancake Bay, 41K/15), was mapped at a scale of 1:50,000 for publication at 1:100,000. Mapping emphasis was placed on the more heavily drift covered lowland areas.

PHYSIOGRAPHY

The physiography is structurally controlled and may be divided into lowlands underlain by red Cambrian sandstones (Jacobsville Formation) and rolling to rugged highlands underlain by Early to Late Precambrian rocks of plutonic, volcanic, and sedimentary origin. Thick Quaternary sediments occupy the lowlands while the uplands are sporadically veneered with till or bouldery sand.

QUATERNARY GEOLOGY

Striations on bedrock indicate a primarily southerly ice flow during the most recent glaciation (Late Wisconsinan). Till outcroppings within the lowlands consist of grey, stoney, sandy silt till which oxidizes to a reddish brown colour; local till derived directly from Jacobsville Formation red sandstones is very sandy, red, and difficult to identify as till. Stony to bouldery, grey, sandy silt till occurs in the uplands; this is frequently overlain by 0.5-2.0 (2-6 feet) of bouldery fine sand.

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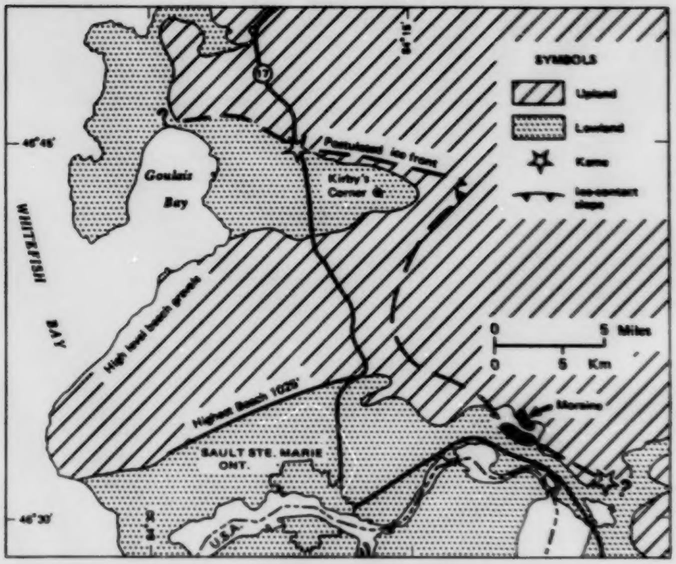

Figure 1 - Postulated ice-frontal position at about the time of Main Lake Algonquin.

Features indicating ice-marginal positions during glacier retreat (Figure 1) are sparse and consist of: isolated kames 3 km (2 miles) northeast of the hamlet of Goulais River and 7 km (4 miles) southeast of Garden River; two end moraine fragments in the Garden River Valley; and an ice-contact delta or outwash fan 2 km (1 mile) northeast of Bellevue. The latter feature shows that ice lay to the northeast, not to the southwest as interpreted by Hough (1958). These features are believed to be of similar age and appear to represent the ice margin at about the time of Main Lake Algonquin.

Outwash deposits occur as sand veneer over much of the uplands and as terraced valley fills within major valleys. The best developed gravels observed were along the Root and West Root River valleys and along Highway 17 between Sault Ste. Marie and the Goulais River valley.

Lacustrine deposits of the late glacial and postglacial Great Lakes constitute the most abundant Quaternary sediments within the area. In the City of Sault Ste. Marie abandoned lake shoreline have received much attention in the past e.g. Hough (1958, p.235). The highest shoreline occurs along the south-facing front of the Precambrian highlands (Gros Cap) and consists of a large bar developed on outwash or deltaic sands and gravels. Precise levelling shows this bar to have its upper surface between 311 and 312 m (1020-1025 feet). The degree of development of this bar leads the writer to concur with Hough (1958) and Prest (1970) that this is the Main Algonquin shoreline though Saarnisto (1974) considered it to be younger.

High level beach gravels on the south side of the Goulais River valley appear to correlate with those of the Main Algonquin shoreline and would imply that Lake Algonquin was present in the eastern Lake Superior basin; the mature nature of the gravels also imply a sizeable lake. This differs from Hough's (1958) interpretation, which was based on an incorrect interpretation of the ice-marginal position (see above). Saarnisto (1974, p.320) maintained that the earliest waters in the eastern Superior basin were post-Main Algonquin from his interpretation that the high bar deposit at Sault Ste. Marie is not Main Algonquin.

Numerous lower shorelines exist and were surveyed, however the data has not been compiled on these yet; these are mainly erosional and are developed on older lacustrine sediments. The base of the Lake Nipissing bluff occurs at about 187 m (645-650 feet).

In addition to beach gravels there is much near-shore and deltaic sand as well as offshore laminated to varved clay within the area.

Several sites containing organic remains (mainly wood, leafy detritus, and peat) were investigated including that reported by Logan *et al.* (1863) near Goulais Bay. Preliminary radiocarbon age of the latter material, (considered to be pre-Lake Nipissing alluvium) is 6490± 100 years (BGS-373[1]) from a site near Kirby's Corner (elevation 189 m or 620 feet). A date of 4610± 90 (BGS-374) radiocarbon years was obtained from wood underlying about 1 m (3 feet) of sand at the foot of the Lake Nipissing bluff within the City of Sault Ste. Marie (elevation 196 m or 643 feet). A previously reported date (Boissonneau 1968) from the now rehabilitated Elliot's clay pit in Sault Ste. Marie was 3520± 140 years B.P. (GSC-428[2]); this material was obtained from post-Nipissing alluvium below the Lake Nipissing bluff.

ECONOMIC GEOLOGY

Sand and gravel are the only economic commodities presently being extracted from Quaternary sediments. Within and adjacent to the city the large Algonquin bar at the front of the highlands constitutes a sizeable resource. Coarse phases are most common where outwash was brought to the shoreline by south-flowing meltwaters. A particularly good example of this is seen where the West Root River enters the lacustrine environment; here coarse outwash gravel is the predominant sediment and only a veneer of beach material is present. Outwash gravels along Highway 17 and the Searchmont Road have much potential; these are rapidly being built over. The ice-contact delta 2 km (1 mile) northwest of Bellevue is a good prospect as are beach gravels located on the peninsula between Batchawana Bay and Pancake Bay; other beach gravels of interest occur on Batchawana Island, south of Horseshoe Bay, and in the vicinity of Goulais Mission.

Many of the gravels in the area contain friable red sandstone of the Jacobsville Formation; this material may restrict the use of these gravels for some products.

ENGINEERING GEOLOGY

Much of the city is underlain by laminated to varved, highly plastic, clay and clayey silt. Limited surface sampling and field vane testing were carried out for the purpose of determining geotechnical properties.

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[1] Age determination by Brock University, Dept. of Geological Sciences.

[2] Age determination by Geological Survey of Canada.

NO. 26 EVALUATION OF SELECTED GRANULAR AGGREGATE DEPOSITS NORTH SHORES OF LAKES HURON AND SUPERIOR

W.R. Cowan[1]

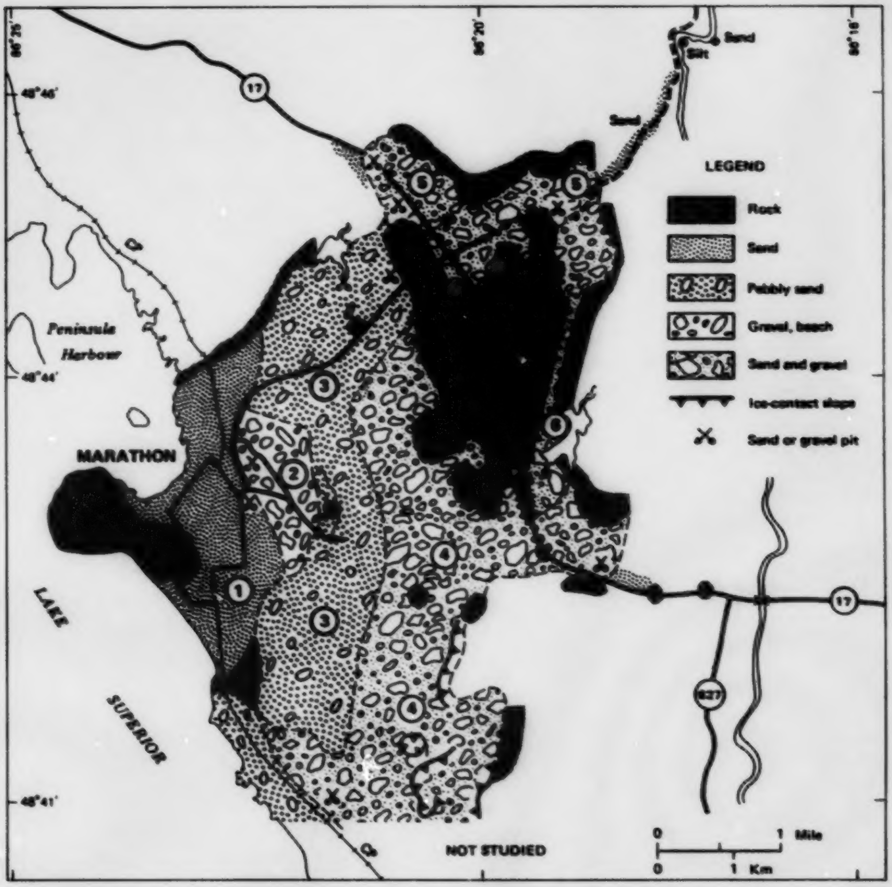
86°25'
86°20'
86°16'
48°46'
48°44'
48°41'
17
Sand
Silt
Sand
LEGEND
Rock
Sand
Pebbly sand
Gravel, beach
Sand and gravel
Ice-contact slope
Sand or gravel pit
Peninsula Harbour
MARATHON
LAKE SUPERIOR
1
2
3
4
5
6
627
Qb
NOT STUDIED
0 1 Mile
0 1 Km

Figure 1 — Quaternary geology of the Marathon area.

In their report on "Aggregate Resources Search - North Shores Lake Superior and Huron" Gartner Lee Associates Limited (1974) recommended that several potentially large sources of granular aggregates be checked in the field. The writer investigated four of these in 1976 at the request of the Division of Mines. Brief investigations were made of the following deposits: Marathon - K19[2]; Pukaskwa - R35; Searchmont - Y54; and North Little Rapids - Z58.

MARATHON - DEPOSIT K19

This deposit (Figure 1) consists primarily of an ice-contact delta with the frontal section reworked into beach gravels and eolian sands.

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[1] Geologist, Phanerozoic Geology Section, Geological Branch, Ontario Division of Mines, Parliament Buildings, Toronto.

[2] Identification number of deposit in report by Gartner Lee Associates Limited (1974).

Map Unit 1: Eolian sands more than 3 m (10 feet) thick. Beach gravels may underlie the sands, however much of this area is within the town of Marathon.

Map Unit 2: Well rounded, coarse beach gravels which may exceed 6 m (20 feet) in thickness. An excellent source of coarse aggregate but is limited in areal extent.

Map Unit 3: Pebbly coarse sand of probable beach origin and containing 5 to 20 percent gravel. An excellent source of fine aggregate with up to 8 m (26 feet) exposed in pits.

Map Unit 4: This is the main deltaic unit and should comprise the principal area of coarse aggregate. Up to 40 m (130 feet) of material is exposed, however rock protrudes at the surface in places. The material is very variable and consists of sand (75 percent) with beds of gravel though good gravel is exposed in the gravel pit on the eastern margin of the deposit which is proximal to the former ice-front.

Map Unit 5: Gravel and sand averaging 70-75 percent sand and more than 7 m (23 feet) thick. Much of this unit is occupied by the Marathon Airport.

Map Unit 6: This was not visited but it consists of rock outcrop and ice-contact gravels.

Evaluation

Unit 2 is an excellent source of coarse aggregates and unit 3 of fine aggregate. The viability of a large export operation depends on the composition of unit 4 which requires much testing for composition and thickness.

PUKASKWA - DEPOSIT R35

The deposit is a glaciolacustrine delta. Helicopter reconnaissance shows it to consist mainly of fine to coarse sand with some pebble beds. Bedrock outcrops are present within the surface area of the main delta but 15 to 60 m (50 to 200 feet) of sand is present elsewhere. Observations provided by the Ontario Soil Survey and by the Precambrian Geology Section support this interpretation.

Though data is scant, this deposit is not a good potential source of coarse aggregate.

SEARCHMONT - DEPOSIT Y54

Surficial mapping of this deltaic deposit indicates that it is primarily sand though up to 5 m (15 feet) of gravel was observed overlying sand near the Goulais River.

It is not considered to be a good source of coarse aggregate for export beyond the area, however a large volume of sand and some coarse material is available for local needs.

NORTH LITTLE RAPIDS - DEPOSIT Z58

This deposit consists of lacustrine sand, probably deltaic, containing 5-20 percent gravel though on the average the top 5 m (15 feet) contains only about 5 percent gravel. This deposit has no immediate importance as a source of aggregate.

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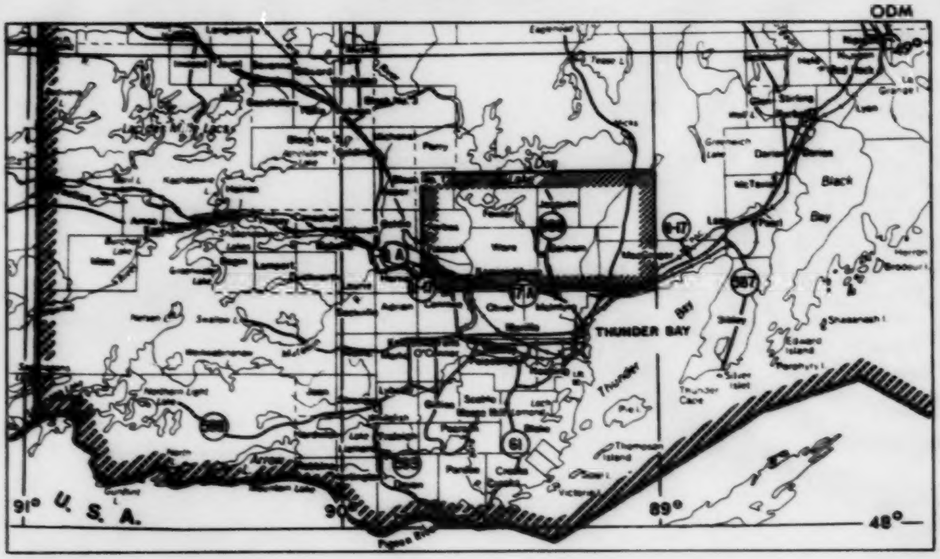
NO. 27 QUATERNARY GEOLOGY OF THE ONION LAKE AND SUNSHINE AREAS

DISTRICT OF THUNDER BAY

G.J. Burwasser[1]



LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

LOCATION

The Onion Lake map-area (NTS 52A/11) is located between Latitudes 48°30'N and 48°45'N and Longitudes 89°00'W and 89°30'W. The Sunshine map-area (NTS 52A/12) is bounded by the same latitudes and extends westerly to Longitude 90°00'W.

Mapping of the Onion Lake area and the east half of the Sunshine Area was completed during the summer of 1976 as shown on the location map.

GENERAL GEOLOGY

The area is underlain by metavolcanics, metasediments and felsic intrusive rocks of Early Precambrian age (Pye and Fenwick 1965). Bedrock is extensively exposed throughout the map-area.

Quaternary deposits consist mainly of fine-grained glaciolacustrine deposits, medium- to coarse-grained outwash and ice-contact materials, and till. One of the three till units mapped within the area was deposited by a general southward movement of the Patrician ice mass. Subsequent ice invasions of the Late Wisconsinan Substage were from the northeast (Dog Lake ice lobe) and the east (Lake Superior ice lobe).

The oldest till unit present was previously described by the author (Burwasser 1975, p.24) as a grey, moderately compact, very stoney sand till with a calcareous, slightly silty matrix which oxidizes to pale brown. Surface exposures of this unit occur patchily throughout the east half of the Sunshine area. It is associated with the Patrician ice sheet which deposited the Brule Creek Moraine, southwest of the map-area, during a general retreat prior to the Valders maximum (Zoltai 1965a, p.266).

The two younger till units are penecontemporaneous deposits of the Dog Lake and Lake Superior lobes. The Dog Lake unit is a stoney sand till containing up to 15 percent clasts ranging from small pebbles to very large boulders. It is exceedingly compact, fissile, grey brown in colour, oxidizing to pale brown. Exposed deposits, commonly less than 1 m

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[1] Geologist, Phanerozoic Geology Section, Geological Branch, Ontario Division of Mines, Parliament Buildings, Toronto.

(3 feet) thick, occur throughout the Onion Lake area with the exception of a 5 km (3 mile) wide band south of the Mackenzie interlobate moraine (*see* Burwasser 1975, Fig. 4 *or* Zoltai 1965b *for generalized Quaternary geomorphology*). The Dog Lake till unit extends beyond the Dog Lake Moraine, previously thought to represent the furthest southerly advance of the Dog Lake ice lobe, into the basin of glacial Lake Kaministikwia. The till related to the Superior ice lobe advance is described by Burwasser (1975, p.26) as fissile, compact, stoney, gritty silt till, brown in colour, and oxidizing to yellow brown. It is exposed on, and south of, the Mackenzie interlobate moraine in the Onion Lake area but extends beyond the Marks Moraine into the glacial Lake Kaministikwia basin.

Outwash and ice-contact deposits are concentrated along the three moraines but long outwash channels also occur, along Sunday Creek, Portage Creek, the Kaministikwia River and Onion Lake-Current River. The smaller outwash channels are sand filled, but the two major channels, Kaministikwia River and Onion Lake-Current River, contain large quantities of gravel especially in their lower reaches. Outwash gravel is found on the south flank of the Mackenzie interlobate moraine west of the community of Mackenzie. From Highway 527 to the Current River much of the outwash material is sand. Several outwash deltas occur along the Dog Lake Moraine. Most prominently developed are those south of Hazelwood Lake and south of Dog Lake. Although quite sandy both deltas contain considerable quantities of gravel in the form of buried beach and nearshore deposits. Buried outwash gravel exists along the Kaministikwia River. Most of these coarse-grained granular deposits have been reworked to some extent by lacustrine wave action. Prominent ice-contact deposits with high gravel content are associated with the Mackenzie interlobate moraine, especially east of Highway 527.

Other than the previously mentioned deltas along the south flank of the Dog Lake Moraine, the major glaciolacustrine deposits in these map-areas are the clays and silts of glacial Lake Kaministikwia. The clays, reddish pink to reddish brown in colour, are varved with brown silt at the base of the depositional lacustrine sequence but become very thinly laminated and finally massive higher in the section. Where exposed along the Kaministikwia River the clay is up to 8 m (25 feet) thick and overlies ice-contact or outwash gravel. Glacial Lake Kaministikwia was bounded on the south by the Marks Moraine but appears to have flooded the Dog Lake Moraine to the north and east.

GRANULAR MINERAL RESOURCES

Major deposits of gravel and sand have been developed in the outwash delta south of Hazelwood Lake, in the ice-contact stratified drift along the Marks Moraine southeast of Toimela, and in the outwash channel along the Kaministikwia River (*see* Burwasser 1975, p.97 *for descriptions of properties*). Much of the readily processed gravel has been removed from the delta area but a considerable quantity of lower grade material remains to be extracted from the buried beach ridges. The Mackenzie interlobate moraine is largely undeveloped east of Stepstone and contains several areas of thick outwash and ice-contact sand and gravel which could supply construction and highway material in the future. West of Stepstone the undeveloped morainic deposits appear thinner and less regular in aggregate content, making them less attractive for effective development. Numerous exposures in the Kaministikwia River channel indicate large quantities of undeveloped outwash sand and gravel.

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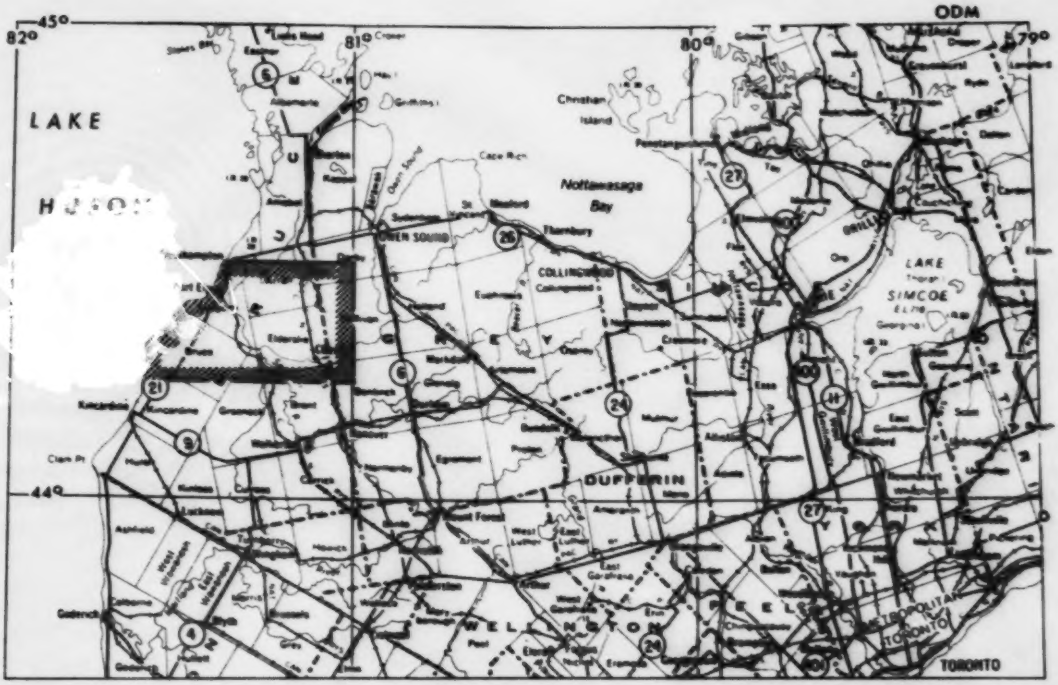
NO. 28 QUATERNARY GEOLOGY OF THE CHESLEY-TIVERTON (41 A/5, A/6) AREA, BRUCE COUNTY

D.R. Sharpe[1]


ODM
45°
82°
81°
80°
79°
44°
LAKE
HURON
Christian Island
Nottawasaga Bay
OWEN SOUND
COLLINGWOOD
ORILLIA
LAKE SIMCOE
DUFFERIN
WELLINGTON
PEEL
METROPOLITAN TORONTO
TORONTO
Goderich

LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

FIELD PROGRAM AND LOCATION

The Chesley-Tiverton area is bounded by Longitudes 81° and 82°W and Latitudes 44°15′ and 44°30′N, and lies south of the Bruce Peninsula along the shore of Lake Huron. This is a pivotal area in the northern link of the Horseshoe morainic system (Taylor 1913). About three-quarters of the mapping is complete in the Chesley-Tiverton map-area.

PHYSIOGRAPHY

The main element of the area is a broad, level to dissected, lacustrine plain which is crossed by several recessional moraines. The lake beds thin to the north exposing a well developed drumlin field. The lake plain is bordered on the east by bouldery ground moraine and on the west by the Algonquin bluff which forms a striking high relief feature running parallel to Lake Huron a few miles inland.

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[1] Geologist, Phanerozoic Geology Section, Geological Branch, Ontario Division of Mines, Parliament Buildings, Toronto.

GEOLOGY

A prominent glacial advance into the region from the northeast deposited a coarse stoney sandy silt till which underlies the whole map-area. It is best exposed in the Tara drumlin field (Chapman and Putnam 1966). This till has been traced from the southeast (Durham sheet) as undifferentiated Elma-Catfish Creek Till (Sharpe 1975). Dark yellowish brown, gritty silt to clayey silt till overlies the coarse till, being mainly confined to morainal ridges. This till forms multiple units in places, a feature which may relate to morainal stacking. However, the occurrence of fine-textured till above and below beach gravel indicates the presence of at least two till units younger than the coarse till. This relationship has only been seen near the Algonquin bluff.

The Gibraltar Moraine and the Banks Moraine (Feenstra 1975) represent strong moraines built by active ice while the Williscroft (new name) and the Tara Moraines (Tara strands of Chapman and Putnam 1966) represent brief standstills of ice probably floating in water. The Gibraltar Moraine is composed of stratified drift and sandy ablation till whereas the Banks and Williscroft Moraines are composed of gritty silt till consisting of reworked lacustrine deposits. The Tara Moraines formed as ice-marginal deltas.

Glaciofluvial deposits in this region are limited in extent. They are concentrated in the Gibraltar Moraine as esker and kame deposits and in the Tara Moraines as ice-marginal deltas.

Damming of the main drainage along the Saugeen Valley by retreating ice led to the formation of a series of glacial lake stages (at least six), at elevations from 282 m (925 feet) down to the modern Lake Huron at 177 m (580 feet). The highest raised beach has been assigned to glacial Lake Warren (Chapman and Putnam 1966) and was correlated with the Gibraltar Moraine by Chapman and Putnam (1966). This moraine has now been correlated with the Banks Moraine by Feenstra (1975). Several weak shoreline features are present between the Warren shoreline and a major shoreline feature representing Lake Algonquin. The latter consists of a high bluff (~ 35 m or 115 feet) with a well developed beach at 226 m (740 feet), at the base. North of North Bruce the shoreline is less spectacular yet consists of a prominent bay-mouth bar crossing the mouth of an early Saugeen River. The Nipissing bluff and beach occur at about 190 m (620 feet) followed by several storm ridges from there to the lake.

RESOURCES

The major supply of sand and gravel for commercial use comes from glacial lake shoreline deposits, yet even this is only sufficient for local needs. An indication of lack of reserves is the opening of pits requiring the stripping of over 10 m of clayey sediments.

Thick drift precludes rock quarrying in the area. In fact rip rap for the local North Bruce Power Development construction comes from Acton.

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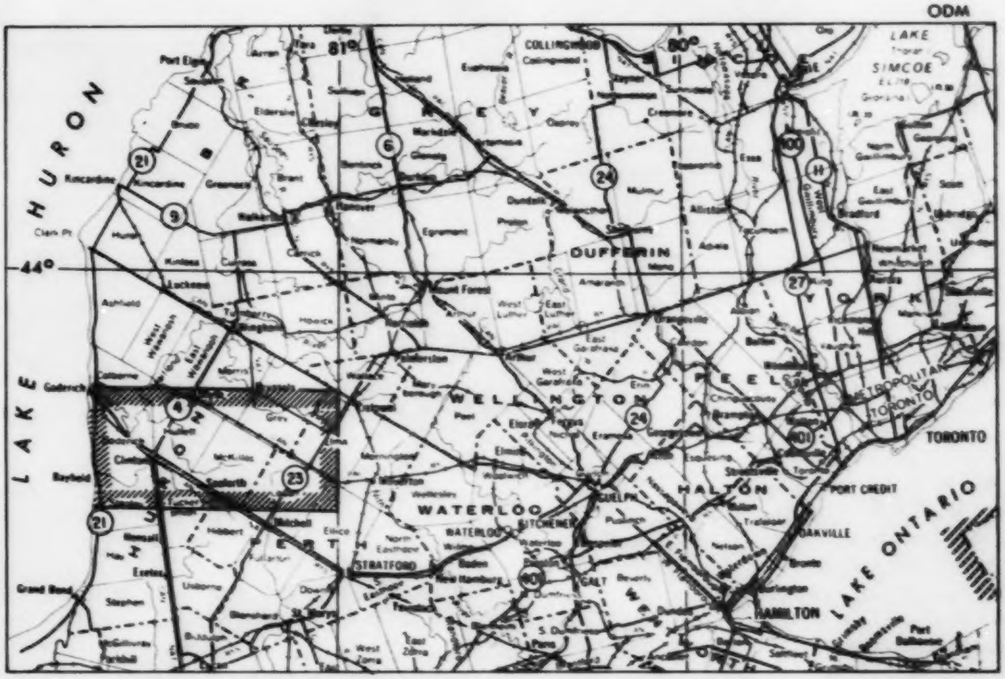
NO. 29 QUATERNARY GEOLOGY OF THE GODERICH (40 P/12) AND SEAFORTH (40 P/11) AREAS HURON AND PERTH COUNTIES

A.J. Cooper[1]


ODM
LAKE HURON
LAKE SIMCOE
LAKE ONTARIO
GREY
DUFFERIN
WELLINGTON
WATERLOO
PERTH
HURON
PEEL
YORK
HALTON
METROPOLITAN TORONTO
TORONTO
GODERICH
SEAFORTH
STRATFORD
KITCHENER
WATERLOO
GUELPH
HAMILTON
OAKVILLE
PORT CREDIT
COLLINGWOOD
81°
80°
44°
21
9
6
24
4
23
27
400
401
11

LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

LOCATION

The Goderich map-area is located between Latitudes 43°45′ and 43°30′N and between Longitude 81°30′W and Lake Huron to the west. The Seaforth map-area extends to the east of the Goderich map-area from Longitudes 81°30′ to 81°00′W and between the same lines of latitude.

Quaternary mapping was begun in the summer of 1975. Initial emphasis was placed on road traverses in an effort to make a preliminary assessment of gravel reserves. During the summer of 1976 emphasis was placed on completing the mapping program, determining stratigraphic relationships, and establishing the boundary between the Rannoch and Elma Tills.

GENERAL GEOLOGY

The area is underlain by limestone of the Dundee Formation and limestone and dolostone of the Detroit River Group. The cherty limestones of the Bois Blanc Formation subcrop near the eastern edge of the Seaforth area. All three formations are of Middle Devonian age. The Dundee and Detroit River rocks are exposed semi-continuously in the Maitland River valley between Goderich and Blyth. Small exposures were found in the Blyth to Brussels area.

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[1] Geologist, Phanerozoic Geology Section, Geological Branch, Ontario Division of Mines, Parliament Buildings, Toronto.

Salt is being extracted from the underlying Upper Silurian Salina Formation at Goderich.

The map-area is dominated by moraines of the Lake Huron ice lobe. These moraines are nearly parallel to the Lake Huron shore and are progressively older eastward from the lake. The Wyoming Moraine is largely composed of St. Joseph Till and was deposited during the most recent (Port Huron) stadial; the Seaforth and Mitchell Moraines are associated with the Rannoch Till and were deposited during the next oldest (Port Bruce) stadial. Several lesser morainic ridges occur within the area of the Rannoch Till.

The three tills mapped in the area closely follow the morainic pattern outlined above. The oldest till is the Elma Till (Karrow 1974a) and is the surface till to the east of the Mitchell Moraine. It is a stony silt to sandy silt till and was deposited from the north by the Georgian Bay lobe during the Port Bruce Stadial.

The Rannoch Till (Karrow 1974b) is a stony silt to sandy silt till and deposited from the west by the Huron lobe ice slightly later than the Elma Till during the Port Bruce Stadial. The Rannoch Till is known to overlie the Elma Till and underlie the St. Joseph Till and is the surface till from the eastern edge of the Wyoming Moraine eastward to and including the Mitchell Moraine. The St. Joseph Till (Cooper and Clue 1974) is the youngest till of the area and is a clayey silt till. The till was deposited during the Port Huron Stadial and is the surface till on the Wyoming Moraine and westward to the lake.

Large amounts of ice-contact stratified drift were observed in the Clinton-Blyth-Auburn area. This material forms the core of the Wawanosh Moraine and is commonly mantled by Rannoch Till. The exposed ice-contact stratified drift showed a dominantly sandy composition. Mapping has indicated that this body of ice-contact material is continuous with the core of the Seaforth Moraine to the south, and it is probable that the Seaforth and Wawanosh Moraines are one feature.

Ice-contact materials, largely eskers and esker complexes, are present along the northern edge of the map-area. The north-south lineation of the esker ridges demonstrates an association with the Elma Till. Esker ridges in east-west orientations are similarly present within the surface area of the Rannoch Till. Stratigraphic sequences in the Maitland and Bayfield Rivers indicate some ice-contact to outwash gravel within the Wyoming Moraine.

Outwash deposits are found along the two major river valleys and along the channel on the distal side of the Wyoming Moraine. The channels and their resultant deposits were formed during the Port Huron Stadial and represent the drainage from the ice sheet while it stood at the moraine and during its retreat. Minor amounts of sandy outwash are present elsewhere throughout the map-area.

The oldest proglacial lake recorded in the area is Lake Warren. Up to three shoreline ridges are present, along with a sandy gravel deposit, between 225 m (740 feet) and 242 m (800 feet) a.s.l. on the western side of the Wyoming Moraine. A very poorly developed feature which may be a shoreline is developed on the Lake Warren plain at about 210 m (700 feet). This feature may be a shoreline of Lake Lundy or it could be an offshore bar in Lake Warren. Elevated alluvial terraces formed during the existence of Lake Algonquin occur at several places along the Lake Huron shore.

ECONOMIC GEOLOGY

Salt from the Silurian Salina Formation is mined by both brine well and shaft methods at Goderich. Small scale, natural gas production has been achieved from a small pinnacle reef in the Guelph Formation near the town of Bayfield in Stanley Township.

Gravel is in good supply in the area and is sufficient to meet local demands for a considerable length of time. Goderich and Colborne Townships have sufficient reserves to export aggregates. The outwash deposits along the outer edge of the Wyoming Moraine presently support two permanent extraction operations. The ice-contact deposits in the Clinton-Auburn-Blyth area have been used for aggregate intermittently but textural variability is a problem. The eskers associated with both Rannoch and Elma Tills have been mined for some time and one permanent operation exists near the town of Seaforth. Locally, high chert contents have been observed but do not pose a major problem to existing producers.

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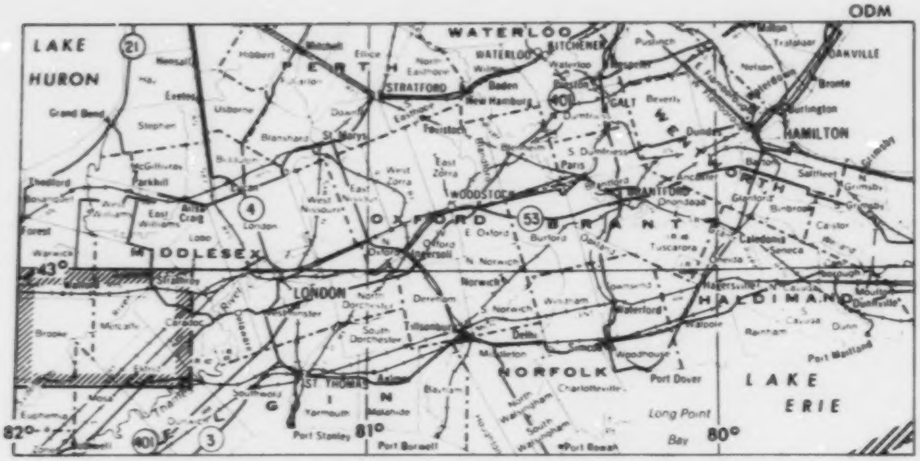
NO. 30 QUATERNARY GEOLOGY OF THE STRATHROY (40 I/14) AREA

MIDDLESEX AND LAMBTON COUNTIES

A.J. Cooper[1]



LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

LOCATION

The Strathroy area is located between Latitudes 42°45′ and 43°00′N and Longitudes 81°30′ and 82°00′W.

Quaternary mapping was begun in the northern part of the area late in the summer of 1976.

GENERAL GEOLOGY

The bedrock of the area is largely covered by Quaternary deposits but well logs indicate the presence of the Hamilton Formation of Middle Devonian age in the eastern two-thirds of the map-area (Hewitt 1972). The Hamilton Formation is exposed in the Parkhill map-area to the north and is composed of grey shale and limestone. The Kettle Point Formation of Upper Devonian age forms the bedrock in the western third of the area. There are several small exposures of this rock in the Sydenham River valley near Alvinston.

The Seaforth Moraine is the dominant physiographic feature in the Strathroy area. The moraine can be traced southward into the area near Hickory Corner. From there it trends westward to the town of Wisbeach, where it trends abruptly southward toward the town of Watford, at which point it is no longer distinguishable as a moraine. The area south of the Seaforth Moraine is essentially a flat dissected plain composed of till and fine-grained lacustrine sediments. This plain is mantled by up to 5 m (16 feet) of eolian sand in the northeastern quadrant of the map-area.

Initial investigations in the field indicate a more complex geological history than the physiographic map (Chapman and Putnam 1972) would indicate. Although mapping has not been completed, it would appear that there are five proglacial lakes represented in the map-area near Watford: two Lake Warren strands, Lake Arkona, Lake Whittlesey and Lake Maumee. The St. Joseph, Rannoch and Southern tills have been traced into the map-area from the Parkhill map-area (Cooper and Clue 1976; Cooper 1976) to the north, and it would appear that there is at least one more silt-clay till on the northern edge of the Strathroy area. One additional till, possibly the Port Stanley Till, has been located in the southeastern corner of the map-area.

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[1] Geologist, Phanerozoic Geology Section, Geological Branch, Ontario Division of Mines, Parliament Buildings, Toronto.

ECONOMIC GEOLOGY

Gravel resources in the area are meagre and of very poor quality. The shoreline deposits of the proglacial lakes represent the largest source of gravel in the area: most of these deposits are either very small or depleted. Northwest of Kerwood several pits have been excavated in ice-contact stratified drift deposits. These deposits are small, variable and generally quite sandy. Both sources of gravel have a moderate chert content and a high shale content. Petroleum wells are common in the area and oil pools are developed in Silurian pinnacle reefs of the Guelph Formation at Wanstead, Sutorville and Watford (Koepke and Sanford 1965).

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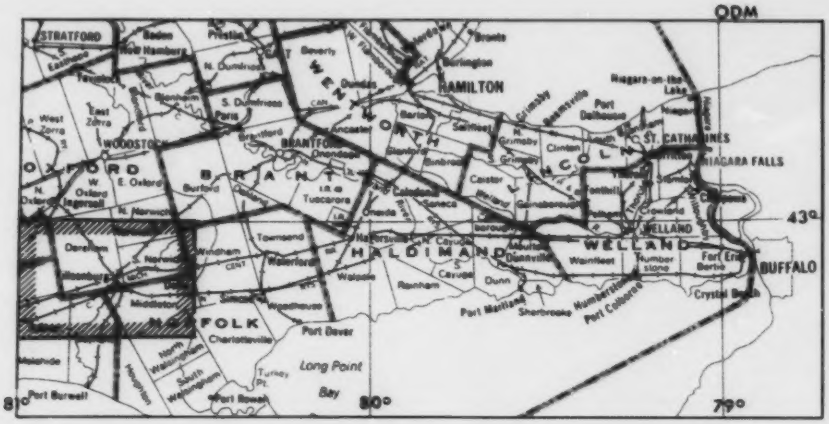
NO. 31 QUATERNARY GEOLOGY OF THE TILLSONBURG (40 I/15) AREA

BRANT, OXFORD, ELGIN, MIDDLESEX, AND NORFOLK COUNTIES

P.J. Barnett[1]



LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

INTRODUCTION

Mapping of the Tillsonburg area was completed during the summer of 1976. The area is located between Latitudes 42°45′ and 43°00′N and Longitudes 80°30′ and 81°00′W. The communities of Aylmer, Tillsonburg, Delhi, Otterville and Norwich are located within the area.

PHYSIOGRAPHY

The Tillsonburg area can be divided into two main physiographic regions: the morainic ridges of the northwest, and the gently rolling lake plain in the south. These regions have been previously described by Chapman and Putnam (1966) under the names of the Mount Elgin Ridges and the Norfolk Sand Plain.

The Mount Elgin Ridges area consists of four major morainic ridges (Ingersol, New Westminster, St. Thomas, and Norwich Moraines) which trend ENE to WSW. Numerous meltwater channels are found between these ridges with local relief up to 30 m (100 feet) within the region.

The Norfolk Sand Plain in contrast is a level plain with minor relief provided by eolian dunes (up to 10 m or 30 feet). A local relief of up to 23 m (75 feet) is found however along the deeply incised valleys of Big Otter, Little Otter and Big Creeks which flow into Lake Erie. The major positive relief feature of this region is the Tillsonburg Moraine.

GENERAL GEOLOGY

No bedrock outcrops were observed during the summer mapping and none have been previously reported. Drift thickness throughout the area is usually greater than 20 m (65 feet) (Sibul 1969).

Three Late Wisconsinan till sheets were identified in the Tillsonburg area. The oldest till, the Catfish Creek (de Vries and Driemanis 1960) is a stony sandy silt till which was deposited during the Nissouri Stadial. It was observed at several localities but its mappable extent was limited.

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The Port Stanley Till (de Vries and Driemanis 1960), a clayey silt to silty clay till, is the next youngest till and was deposited by ice moving to the northwest, out of the Erie basin, during the Port Bruce Stadial. This till is the major surface unit in the northwest half of the map-area and is found at depth throughout most of the area.

The Ingersol, St. Thomas, Norwich, Tillsonburg, and several other minor till ridges mark ice marginal positions during the retreat of the Port Stanley ice into the Erie and Ontario basins. Several layers of till exposed along Big Otter and Big Creeks have been tentatively correlated with the Port Stanley Till.

The youngest till, the Wentworth Till (Karrow 1959) has limited exposure and is found only in the Delhi-Lynedoch area of the map sheet. It is a sandy silt till which represents a glacial advance during the Port Huron Stadial into the Tillsonburg area.

Glaciolacustrine sediments are found covering a large part of the map-area southeast of a line between Norwich and Aylmer. The sands were deposited mainly in the waters of glacial Lake Whittlesey, whereas some of the silts and clays are believed to have been deposited during the several levels of Lake Maumee.

Outwash sediments occur mainly in the meltwater channels between the morainic ridges and along the Thames River at Putnam. Ice-contact deposits are found associated with several of the moraines.

ECONOMIC GEOLOGY

Sand and gravel has been excavated from several pits throughout the Tillsonburg area, in outwash, ice-contact, beach and dune deposits. During the summer, however, only four of these pits were active.

Clay, to be used in the production of tiles and bricks, is being excavated at Norwich, and there is one inactive plant at Brownsville.

At several localities near Verschoyle, muck and peat are being excavated for use in greenhouses and gardens.

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NO. 32 QUATERNARY AGGREGATE RESOURCES IN NORTHWESTERN ONTARIO

E.V. Sado[1]

INTRODUCTION

At the request of the staff of the Northwestern Administrative Region of the Ontario Ministry of Natural Resources, a survey of the granular aggregate potential within that region was undertaken. Locations of existing pits were compiled from Ministry of Transportation and Communications files at Downsview and Thunder Bay and from the District Mining Recorders Offices in that region.

Field studies involved the gathering of geotechnical data to assess the quality, quantity, distribution and genesis of the sand and gravel deposits. Air photographs were used to synthesize the above data.

It must be stressed that this is only a preliminary evaluation done on a regional scale. The purpose was to determine where sizeable resources of granular aggregate exist within the region. Further work will be necessary to accurately define specific aggregate potential zones.

LOCATION AND ACCESS

The Northwestern Region is bordered to the west, south, east and north by the Province of Manitoba, the State of Minnesota, and the North Central and Northern Ontario Administrative Regions. Regional administration is handled in Kenora with six district offices located in Dryden, Fort Frances, Ignace, Kenora, Red Lake and Sioux Lookout.

The region is accessible via Highways 17 and 11. A secondary highway and resource road network permits access into the hinterland. Fieldwork performed for this study was restricted to these access routes.

GENERAL GEOLOGY

The Northwestern Region lies within the Canadian Shield, and is underlain by Early Precambrian rocks. "Greenstone" belts consist of metamorphosed, complexly folded volcanic, sedimentary and intrusive rocks, and are separated by large expanses of banded gneiss and granitic rocks.

Glacial scouring during the Pleistocene Epoch remoulded this rock surface and produced the mantle of rock debris overlying it. Ground moraine is the most common glacial deposit. It consists of a sandy till containing a wide assortment of angular bedrock fragments. A younger clayey till is found in the Rainy River-Fort Frances area.

The oscillating margins of the last continental ice sheets formed several prominent end moraines in the region (Prest 1963; Zoltai 1965). Substratified drift, over 60 m (200 feet) thick in places, was deposited along these moraines. Other sand and gravel bearing deposits, namely eskers, kames and outwash plains, formed penecontemporaneously.

Meltwaters ponded against the retreating ice margins innundated an area of some 520,000 km^2 (200,000 square miles). In the study area this glacial lake named Agassiz formed thick gravel beach terraces along the morainic surfaces and a thick sequence of varved clays precipitated adjacent to the morainic flanks and over much of the area.

SAND AND GRAVEL RESOURCES

Fort Frances District

An anomalously heavy drift area occurs west of a line joining Lake of the Woods, Lake Despair and Rainy Lake. A thick mantle of varved clays and clay till obscures all but the highest bedrock peaks producing a characteristically flat topography.

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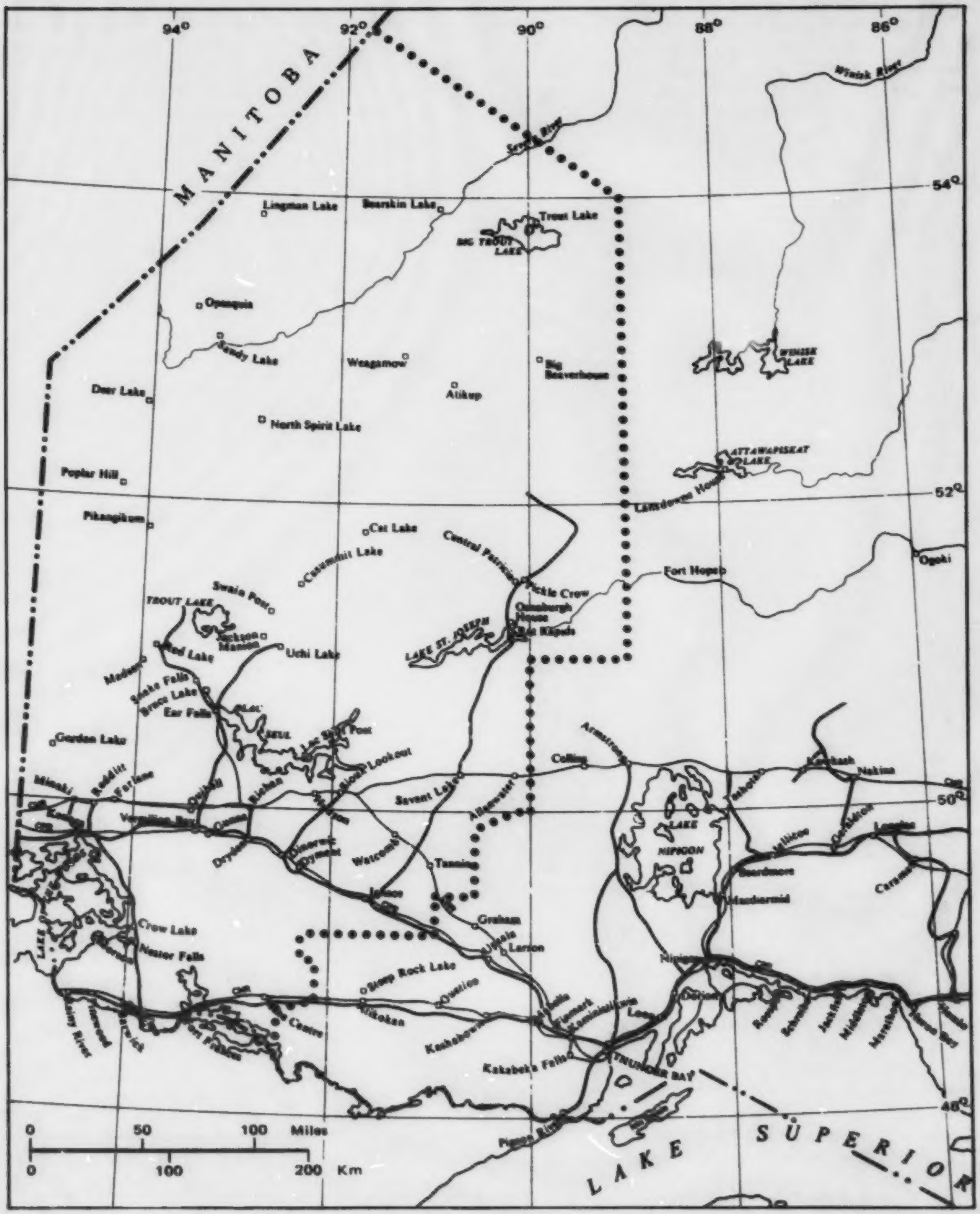
94°
92°
90°
88°
86°
54°
52°
50°
48°
MANITOBA
Severn River
Winisk River
Lingman Lake
Bearskin Lake
Trout Lake
BIG TROUT LAKE
Opasquia
Sandy Lake
Weagamow
Big Beaverhouse
Atikup
WINISK LAKE
Deer Lake
North Spirit Lake
ATTAWAPISKAT LAKE
Poplar Hill
Lansdowne House
Pikangikum
Cat Lake
Central Patricia
Casummit Lake
Fort Hope
Ogoki
Swain Post
Pickle Crow
TROUT LAKE
Osnaburgh House
Rat Rapids
LAKE ST. JOSEPH
Jackson Manion
Red Lake
Uchi Lake
Madsen
Snake Falls
Bruce Lake
Ear Falls
LAC SEUL
Lac Seul Post
Sioux Lookout
Gordon Lake
Armstrong
Collins
Kowkash
Nakina
Minaki
Redditt
Farlane
Savant Lake
Allanwater
Vermilion Bay
Kenora
Dryden
Dinorwic
Dyment
Watcomb
Tannin
LAKE NIPIGON
Geraldton
Longlac
Beardmore
Macdiarmid
Caramat
Ignace
Graham
Upsala
Larson
Crow Lake
Nestor Falls
LAKE OF THE WOODS
Steep Rock Lake
Nipigon
Dorion
Atikokan
Kashabowie
Finmark
Kaministiquia
Rossport
Schreiber
Jackfish
Marathon
Heron Bay
Rainy River
Barwick
Fort Frances
Mine Centre
Kakabeka Falls
THUNDER BAY
Pigeon River
LAKE SUPERIOR
0
50
100
Miles
0
100
200
Km

LOCATION MAP

Granular deposits are common at the surface; they are generally thin, discontinuous, beach or beach-modified sandy materials. At depth, 1-15 m (3-50 feet) below the clay overburden, thick sequences of gravelly sands have been exposed. More work is necessary to outline the aggregate potential of these buried deposits.

Sizeable reserve areas have been outlined near Fort Frances, Stratton, Rainy River and Finland.

A typical shield terrain characterizes the remaining part of the district. The relief is rugged with numerous lakes, and bedrock exposures common, protruding through a variable thickness of sandy till and varved clay.

Aggregate zones here tend to be thinly spread and local. Larger concentrations were outlined along Highway 11 near Flanders, Bennett Lake and surrounding Mine Centre. A small morainic zone between Lake of the Woods and Rainy Lake has significant aggregate potential.

Where sorted aggregate is absent the sand till is often used as a granular substitute.

Kenora District

Erosion has stripped much of the overburden mantle in this area. Large tracts of bare bedrock are common. Numerous small sandy deposits exist close to Highway 71, and those closest to the highway have already been largely depleted.

A large outwash deposit extends several kilometres east of Kenora. It consists mainly of sand, and the stone potential is poor; favourable coarse aggregate zones within it are largely unavailable for extraction because an airport, powerlines and a transformer station are located on the deposit. West of Kenora aggregate potential is limited to a small deposit between Moth and Granite Lakes.

Dryden, Ignace, Red Lake and Sioux Lookout Districts

Massive aggregate potential is concentrated within and alongside four prominent end moraine ridges. These deposits, the Eagle Lake-Finlayson Moraine, the Hartman Moraine, the Lac Seul Moraine and the smaller Sioux Lookout Moraine, trend southeasterly from Red Lake to Dryden and through the Ignace area. Another large morainic mass, (Agutua Moraine) parallel to these is found northeast of Pickle Lake.

Internally these morainic materials consist of substratified, slumped and faulted seams of sand, silt, gravel and till-like materials characterized by abrupt changes in grain size. The morainic surfaces have been modified by extensive lake action. Thick, well sorted cobbly gravel deposits were formed along the crests and in beach scarps cut into the morainic flanks. Several original kame moraine surfaces are preserved east of Dryden and through Ignace.

Large outwash bodies occur adjacent to the morainic margins. These deposits are typically fine- to medium-textured, gravelly sands occurring along horizontal to gently foreset beds. A very large, concentric outwash complex onlaps morainic materials for a distance of over 160 km (100 miles) between Ignace and Raith in North Central Region.

Numerous eskerine deposits exist in this region, particularly to the north. Coarse aggregate is concentrated within their core while the flanks tend to be sandy.

Thick sequences of varved clay often mask underlying aggregate.

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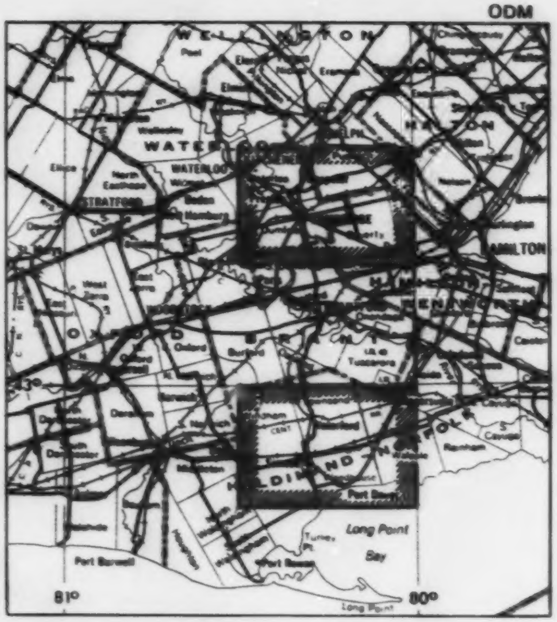
NO.33 PALEOZOIC GEOLOGY OF THE CAMBRIDGE AND SIMCOE AREAS

SOUTHERN ONTARIO

P.G. Telford[1]



LOCATION MAP Scale: 1 inch to 25 miles

LOCATION

During the summer of 1976 geological mapping was completed for the Cambridge (40 P/8) and Simcoe (40 I/16) map-areas. The former is bounded by Latitudes 43°30'N and 43°15'N and Longitudes 80°00'W and 80°30'W, and the latter is bounded by Latitude 43°00'N, Longitudes 80°00'W and 80°30'W, and Lake Erie in the south.

GENERAL GEOLOGY

Cambridge Map-Area

Outcrops of Paleozoic bedrock are abundant in the eastern half of the map-area and commonly form prominent cliffs along the banks of the Grand River near and within the City of Cambridge. The latter exposures were examined in 1975 (Telford 1975). Exposures in the east represent two major Middle Silurian stratigraphic units, the Amabel and Guelph Formations; included within the Amabel Formation is the distinctive Eramosa Member (Table 1).

The Amabel Formation, excluding the Eramosa Member, consists of massive, light bluish-grey, finely crystalline dolostone. It commonly forms reefal and biohermal mounds containing porous, fossiliferous dolostone. The Eramosa Member, which forms the upper part of the Amabel Formation, consists of medium to thin-bedded, dark brown, strongly bituminous dolostone. The overlying Guelph Formation is comprised of massive and thick-bedded, light brown, sucrosic dolostone and also contains reefal and biohermal mounds.

The Upper Silurian Salina Formation underlies that part of the map-area west of the Grand River but no exposures are known. The extreme southeast corner of the area is underlain by

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TABLE 1 GENERAL STRATIGRAPHY OF THE CAMBRIDGE AND SIMCOE MAP-AREAS.

MIDDLE DEVONIAN	Dundee Formation*	Simcoe Map-area
	Onondaga Formation	
	Moorehouse Member*	
	Clarence Member	
	Edgecliff Member*	
LOWER DEVONIAN	Bois Blanc Formation*	
	Springvale Sandstone Member	
UPPER SILURIAN	Bertie Formation	
	Salina Formation	Cambridge Map-area
MIDDLE SILURIAN	Guelph Formation	
	Amabel Formation	
	Eramosa Member	

(*Formation or member sampled for conodonts.)

strata that are older than the Amabel Formation but, again, no exposures are known.

Simcoe Map-Area

Outcrops of Paleozoic strata are common along the Lake Erie shoreline and along numerous small creeks draining the eastern half of the map-area. Several operating and abandoned quarries in the Hagersville, Jarvis, and Nanticoke areas also provide excellent stratigraphic sections. The general stratigraphy of the Simcoe map-area is indicated on Table 1.

There are no known exposures of the Salina Formation which underlies the northern edge of the map-area. However there are numerous outcrops of the overlying Bertie Formation which forms a prominent east-west ridge in the northeastern part of the area. The Bertie consists mainly of well-bedded, blocky weathering, light brown, finely crystalline dolostone; shaley weathering, argillaceous dolostone occurs in the lower part of the unit. Disconformably overlying the Bertie Formation is the Bois Blanc Formation which consists mainly of grey, argillaceous, fossiliferous, very cherty limestone with minor dolostone and shale. In the lower part of this unit at various localities is a glauconitic, quartzose sandstone that is commonly referred to the Springvale Sandstone Member.

Overlying the Bois Blanc is the Onondaga Formation which is divided, tentatively, into three members (Table 1). The lower or Edgecliff Member is a medium-bedded, occasionally cherty, very fossiliferous, crinoidal bioclastic limestone. The middle or Clarence Member is a thick- to medium-bedded, very cherty, poorly fossiliferous limestone. The upper or Moorehouse Member is very similar lithologically to the Edgecliff Member, consisting of medium-bedded, moderately cherty, very fossiliferous, bioclastic limestone. Accurate boundaries between these members are difficult to define because of lack of adequate exposure, but they are probably transitional. Corals are the dominant fossils in the Onondaga Formation; crinoids, brachiopods, trilobites, bryozoa and gastropods are less common elements of the fossil fauna. To the west, facies changes occur and laterally equivalent strata are referred to the Detroit River Group. However the precise limits of the Onondaga Formation and Detroit River Group have yet to be determined.

The uppermost Paleozoic unit in the map-area is the Dundee Formation which consists of medium-bedded, brown, moderately cherty, fossiliferous, micritic limestone. Brachiopods are the dominant fossils. Two, thin but distinctive beds of black, bituminous, argillaceous limestone occur in the lower part of the unit and are useful for correlation. For the first time, the contact between the Dundee and underlying Onondaga Formation has been recognized in outcrops along Sandusk Creek and in the Stelco quarry at Nanticoke.

ECONOMIC GEOLOGY

In the Cambridge map-area the quarries of Domtar Chemicals Limited near Hespeler and Flamboro Quarries Limited at Flamboro are excavating Guelph and Eramosa dolostones respectively. The large outcrop areas of the Amabel Formation in the eastern part of the region are suitable for further industrial mineral extraction activities.

In the Simcoe map-area the quarries of Haldimand Quarries and Construction Limited (Hagersville) and Nanticoke Crushed Stone (Jarvis) are excavating Bois Blanc and Onondaga limestone. Quarries of the Steel Company of Canada (Nanticoke) and Norfolk Quarry Company (Port Dover) are excavating the Dundee Formation.

These and other abandoned operations are described in more detail by Hewitt (1960) and Hewitt and Vos (1972).

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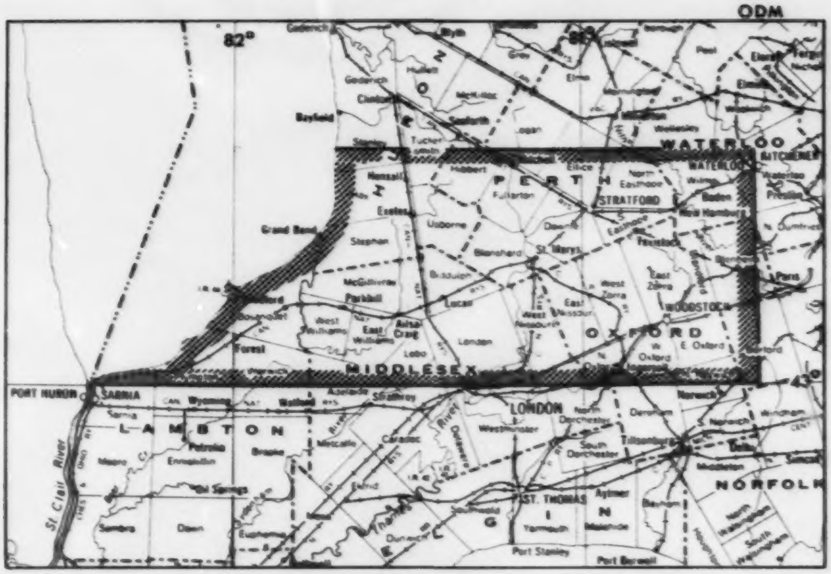
NO. 34 PALEOZOIC GEOLOGY OF THE WOODSTOCK-GRAND BEND AREA

SOUTHERN ONTARIO

P.G. Telford[1]


ODM
82°
81°
43°
WATERLOO
PERTH
STRATFORD
St. Marys
WOODSTOCK
OXFORD
MIDDLESEX
LONDON
LAMBTON
NORFOLK
ELGIN
PORT HURON
SARNIA
Grand Bend
Parkhill
Lucan
St. Clair River
ST. THOMAS
Port Stanley

LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

LOCATION

During the summer of 1976 geological mapping and subsurface data compilation was completed for the Woodstock (40 P/2), Stratford (40 P/7), Lucan (40 P/3), St. Marys (40 P/6), Parkhill (40 P/4), Grand Bend (40 P/5), and Perch (40 O/1) map-areas. This region is bounded by Latitudes 43°30′ and 43°00′N, Longitudes 80°30′W, and partly by 82°30′W and the Lake Huron shoreline.

GENERAL GEOLOGY

Outcrops of Paleozoic bedrock are very sparse in this region so that subsurface data, obtained from oil and gas drilling records, were used to supplement the field mapping. For example, there are no known bedrock exposures in the Stratford and Grand Bend map-areas. Only a few outcrops were found in the Perch and Lucan map-areas while quarries provided the only adequate exposures in the Woodstock and St. Marys map-areas. In the Parkhill map-area, bedrock exposures were numerous only along the deeply incised valley of the Ausable River and in the vicinity of Thedford. Fortunately there has been a great deal of oil and gas exploration in the region, providing much subsurface information, and relatively thorough compilation was possible.

The Paleozoic stratigraphy of the Woodstock-Grand Bend area is summarized in Table 1. The Upper Silurian Salina Formation directly underlies the eastern parts of the Woodstock and Stratford map-areas but no surface exposures of this unit are known. The overlying

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TABLE 1 GENERAL STRATIGRAPHY OF THE WOODSTOCK-GRAND BEND REGION.

UPPER DEVONIAN	Kettle Point Formation*
MIDDLE DEVONIAN	Hamilton Group
	Ipperwash Formation (limestone)*
	Widder Formation (mainly shale)*
	Hungry Hollow Formation (limestone)*
	Arkona Formation (shale)*
	Rockport Quarry Formation (limestone)
	Bell Formation (shale)
	Dundee Formation*
	Detroit River Group
	Lucas Formation*
	Amherstburg Formation*
LOWER (?) DEVONIAN	Bois Blanc Formation*
UPPER SILURIAN	Bass Islands Formation
	Salina Formation

(*Formation sampled for conodonts.)

Upper Silurian Bass Islands Formation constitutes the bedrock of a narrow strip extending approximately north-south through the Stratford and Woodstock map-areas. The only exposures of this dolostone unit are near the town of Innerkip (Woodstock map-area).

The disconformably overlying, Lower or Middle Devonian Bois Blanc Formation consists of irregularly bedded, very cherty, fossiliferous limestone and dolostone. It also forms the bedrock of a narrow strip extending approximately north-south through the Stratford and Woodstock map-area. The only exposure of the unit is in an abandoned quarry at Innerkip. Overlying the Bois Blanc Formation is a thick sequence of limestones and dolostones assigned to formations of the Middle Devonian Detroit River Group (Table 1). These units form the bedrock of the western halves of the Woodstock and Stratford map-areas, the eastern half of St. Marys map-area, the northeastern portion of Lucan map-area, and several small inliers in the Grand Bend map-area. The best exposures of the Detroit River Group are in several large quarries near Beachville and Zorra (Woodstock map-area). Father east, facies changes occur and laterally equivalent strata are assigned to the Onondaga Formation. However, the precise limits of the Onondaga Formation and Detroit River Group have yet to be determined.

Overlying the Detroit River Group is the Dundee Formation which consists mainly of medium- to thick-bedded, fossiliferous, micritic limestone. It forms the bedrock of most of the Lucan and Grand Bend map-areas, the west half of St. Marys map-area, and the east half of Parkhill map-area. However, outcrops of the unit are uncommon, with the only extensive exposures occurring in the St. Marys Cement Company quarry at St. Marys.

Conformably overlying the Dundee Formation is a sequence of shales and thin limestone units assigned to the Hamilton Group (see Table 1). These units constitute the bedrock of much of the western half of the Parkhill map-area and several portions of Perch map-area. Definite exposures of the lower two formations (Bell and Rockport Quarry) are not known in the Parkhill and Perch map-areas. The next three overlying formations (Arkona, Hungry Hollow, and Widder) are well exposed along the Ausable River near Arkona and in a clay pit at Thedford (Parkhill map-area). The Hungry Hollow and Widder Formations are famous for their extremely rich fossil fauna. Brachiopods, in particular, are most abundant and several new fossil localities were discovered and sampled thoroughly during the 1976 field season. The uppermost formation of the Hamilton Group (Ipperwash) is exposed only at Stony Point on Lake Huron (Parkhill map-area). All of these limestone and shale units could be recognized easily in drilling records, using either chip samples or electric logs, and precise correlation based on a combination of the surface and subsurface data is possible.

Overlying the Hamilton Group are distinctive black shales of the Upper Devonian Kettle Point Formation. They form the bedrock of the extreme western part of the Parkhill map-area and much of Perch map-area. However, their only known exposure in these map-areas is at Kettle Point on Lake Huron (Perch map-area). Large calcareous concretions (locally termed "kettles") are common in this unit and microfossils, including conodonts and the spore *Tasmanites*, can often be seen on bedding surfaces.

ECONOMIC GEOLOGY

Only three stratigraphic units of the Woodstock-Grand Bend area are being used at present as an industrial mineral resource. High purity limestone of the Lucas Formation (Detroit

River Group) is quarried at Beachville by Domtar Chemicals Limited, Steel Company of Canada, and Beachvilime Limited, and at Zorra by Canada Cement Lafarge Limited. The Dundee Formation is quarried by St. Marys Cement Company at St. Marys and shale of the Arkona Formation (Hamilton Group) are excavated at Thedford for the manufacture of sewer pipe. Areas suitable for further industrial mineral extraction are limited due to the generally high thickness of glacial deposits covering the Paleozoic bedrock.

Exploration for gypsum was carried out in the Drumbo area (Woodstock map-area) during the 1960s (Guillet 1964) but no mining has taken place.

There has been considerable oil and gas exploration activity in the Woodstock-Grand Bend area and there are several producing fields, in the Woodstock and Parkhill map-areas, e.g. Gobles field near Woodstock and the Grand Bend field near Parkhill. Most of the production is from pinnacle reefs of the Middle Silurian Guelph Formation although Cambrian sandstones deep in the subsurface are proving to be rich reservoir units.

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Geophysics/
Geochemistry
Section

GEOPHYSICAL, GEOCHEMICAL AND GEOCHRONOLOGICAL SURVEYS, 1976

K.D. Card[1]

Staff of the Geophysics-Geochemistry Section conducted one geophysical survey project and three geochemical survey projects in the field during the summer of 1976. Preliminary geochronological studies were carried out in parts of the Abitibi, Uchi Lake, Sturgeon Lake and Manitou Lakes metavolcanic-metasedimentary belts in conjunction with staff of the Geochronology Laboratory at the Department of Mineralogy and Geology, Royal Ontario Museum. In addition, the section planned and co-ordinated airborne radiometric and geochemical surveys which were carried out under the Federal-Provincial Uranium Reconnaissance Program.

A gravity-magnetic susceptibility survey over the Red Lake metavolcanic-metasedimentary belt, District of Kenora, was carried out by Gupta and Wadge to outline the deeper geological and structural characteristics of the belt, to permit interpretation of its configuration in the third dimension and to collect data on the magnetic susceptibility of the various rock units for improved interpretation of aeromagnetic data. This project is part of an on-going program to define the deeper structural characteristics of the Precambrian Canadian Shield of Ontario and thus arrive at a better understanding of its evolution, especially the metavolcanic belts and their mineral deposits. Preliminary results of similar gravity surveys carried out in 1974 and 1975 over the Sturgeon Lake and Uchi Lake metavolcanic-metasedimentary belts have been published in the form of Bouguer gravity maps.

Studies to assess the geochemical-geological relationships of pyritic and graphitic volcanogenic rocks and stratabound massive sulphide deposits were carried out in the Confederation Lake and Red Lake areas, District of Kenora by Closs in conjunction with A.C. Colvine of the Mineral Deposits Section. These investigations are part of an on-going program to investigate the genesis of such deposits and to evolve methods for their exploration.

A program of reconnaissance geochemical sampling of Paleozoic rocks in southern Ontario was carried out by Closs. These samples will be chemically analyzed in order to establish regional compositional variations, especially of trace metals, and the data gained will be of use in establishing background

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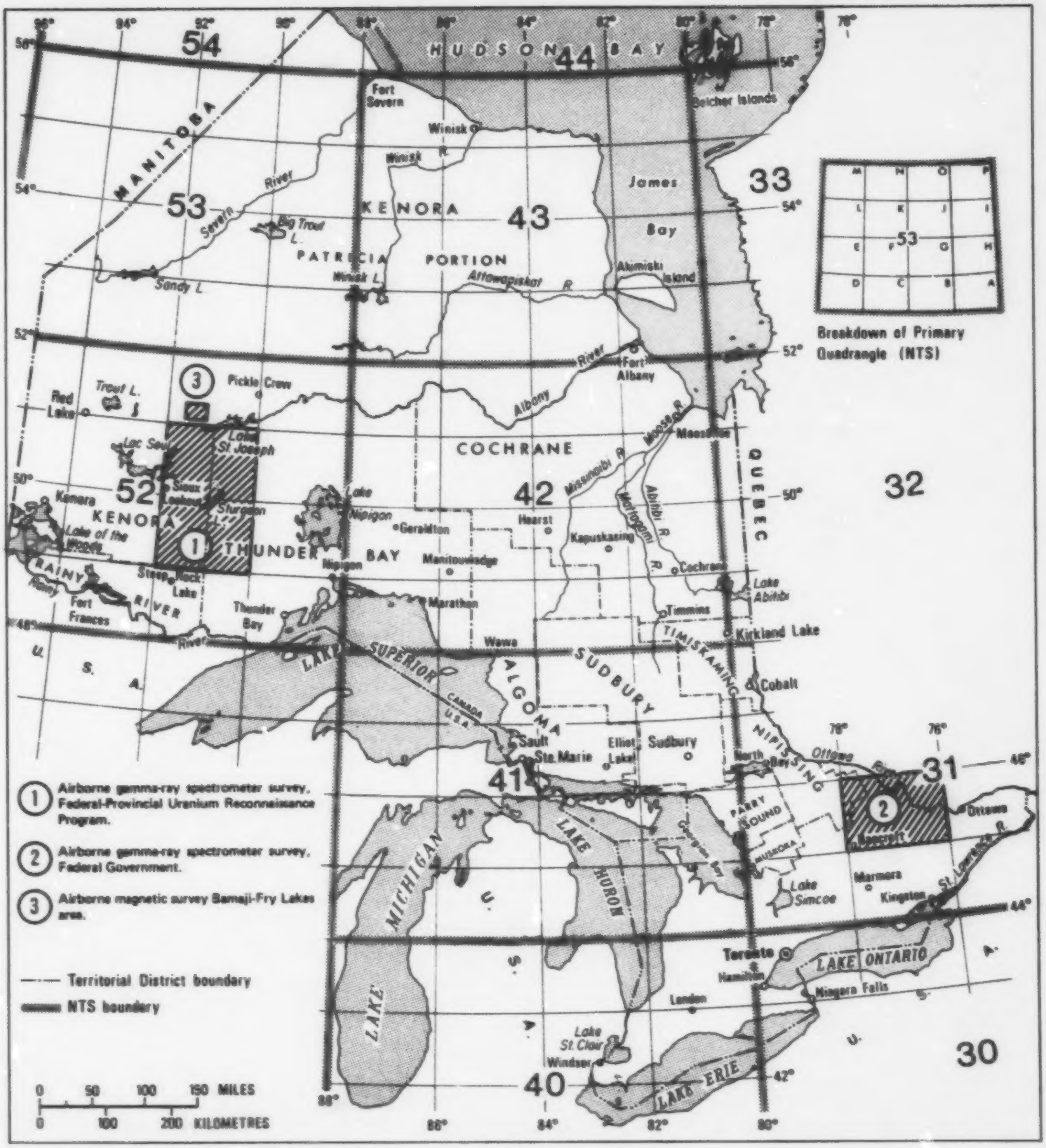

HUDSON BAY
James Bay
Belcher Islands
Akimiski Island
Fort Severn
Winisk
Fort Albany
Moosonee
MANITOBA
KENORA
PATRICIA PORTION
COCHRANE
THUNDER BAY
RAINY RIVER
ALGOMA
SUDBURY
TIMISKAMING
NIPISSING
PARRY SOUND
MUSKOKA
QUEBEC
U.S.A.
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ONTARIO
LAKE ERIE
Red Lake
Pickle Crow
Lac Seul
Lake St. Joseph
Sioux Lookout
Sturgeon
Kenora
Lake of the Woods
Steep Rock Lake
Fort Frances
Thunder Bay
Nipigon
Lake Nipigon
Geraldton
Manitouwadge
Marathon
Wawa
Hearst
Kapuskasing
Cochrane
Timmins
Kirkland Lake
Cobalt
Sault Ste. Marie
Elliot Lake
Sudbury
North Bay
Ottawa
Bancroft
Marmora
Kingston
Lake Simcoe
Toronto
Hamilton
Niagara Falls
London
Lake St. Clair
Windsor
54
53
52
44
43
42
41
40
33
32
31
30
Breakdown of Primary Quadrangle (NTS)
M N O P
L K J I
E F 53 G H
D C B A
① Airborne gamma-ray spectrometer survey, Federal-Provincial Uranium Reconnaissance Program.
② Airborne gamma-ray spectrometer survey, Federal Government.
③ Airborne magnetic survey Bamaji-Fry Lakes area.
Territorial District boundary
NTS boundary
0 50 100 150 MILES
0 100 200 KILOMETRES

Figure 1

metal contents for environmental studies and geochemical prospecting purposes.

Card, in conjunction with D.G. Innes, Mineral Deposits Section, carried out stratigraphic and geochemical studies of the Huronian Espanola Formation and associated base-metal deposits in the North Shore of Lake Huron region, Districts of Sudbury and Algoma as part of a program to investigate the genesis of these rocks and mineral deposits and to outline areas for base-metal exploration.

A reconnaissance airborne gamma-ray spectrometer survey for uranium is being conducted in the Dryden-Deer Lake area, Districts of Kenora and Rainy River (see 1 on Figure 1) as part of the joint federal-provincial uranium reconnaissance program. A reconnaissance lake-sediment geochemical survey, also a part of the federal-provincial program, is being conducted in the Pembroke-Kingston area, southeastern Ontario (see 2 on Figure 1).

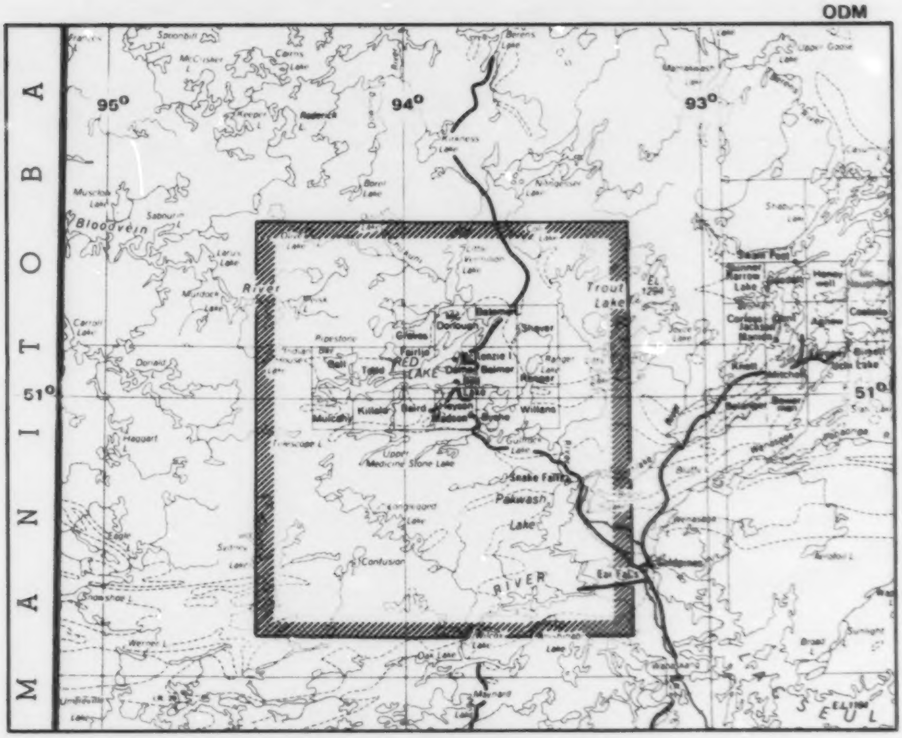
The results of a Federal-Provincial airborne gamma-ray spectrometer survey in the Ignace-Sioux Lookout area, Districts of Kenora and Thunder Bay (see Figure 1) were released to the public in June, 1976. In addition, the federal government released the results of a similar airborne radiometric survey in the Pembroke area of southeastern Ontario in June, 1976 (see Figure 1).

The results of a residual, low-level airborne magnetometer survey covering approximately 500 km^2 (200 square miles) in the Bamaji-Fry Lakes area, District of Kenora (see 3 on Figure 1) were released in the spring of 1976.

A program of contract geophysical surveys, including ground resistivity and airborne electromagnetic surveys, to test methods for lignite exploration was carried out over the Onakawana lignite deposit of the James Bay Lowlands, District of Cochrane. The results of these test surveys have been released in the Ontario Division of Mines Open File Report 5196, Report on Geophysical Studies, Onakawana Lignite Fields, District of Cochrane.

NO. 35 GRAVITY AND MAGNETIC SUSCEPTIBILITY SURVEY IN THE RED LAKE AREA, DISTRICT OF KENORA

V.K. Gupta[1] and D.R. Wadge[2]



LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

The objective of the Geological Branch gravity survey program is to obtain detailed gravity data over major parts of the Canadian Shield in Ontario, especially the Early Precambrian metavolcanic-metasedimentary belts. As a part of this program a detailed gravity survey was carried out over the Red Lake metavolcanic-metasedimentary belt during the summer of 1976. In the past, two such surveys have been conducted: in the Sturgeon Lake area (Barlow *et al.* 1975) and the Birch-Uchi-Confederation Lakes area (Barlow *et al.* 1976). Interpretation of the above gravity data is now underway.

In-situ magnetic susceptibility measurements were also made over 200 sites in the Red Lake area. At each outcrop 10 to 15 susceptibility readings were taken.

The Red Lake gravity survey area is bounded by Latitudes 50°30'00"N, and 51°22'30"N, and Longitudes 93°15'00"W and 94°30'00"W, covering an area of approximately 8,500 km^2 (3,300 square miles). A field party, with fixed wing aircraft and helicopter support, established 2,471 gravity stations using three Lacoste-Romberg gravimeters. The gravity station distribution varied from 1 station per 1.3 km^2

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(0.5 square miles) in areas of known metavolcanic rocks to 1 station per 5.7 km^2 (2.2 square miles) in areas of granitic and metasedimentary rocks. The average station density over the entire area was 1 gravity station per 3.5 km^2 (1.3 square miles).

A detailed gravity profile was obtained along the Nungesser road extending north from Highway 125 (near Balmertown) to the Berens River. One hundred and twenty-five gravity stations were established along this road over a distance of 100 km (62 miles).

About 1,300 density measurements were made on rock samples collected from the survey area. The rock samples were identified at the base camp by the Geological Branch staff geologists. The purpose of the density measurements was to determine representative mean densities for the major rock units.

The gravity survey was carried out according to the field procedures and specifications of the Gravity Division (1976), Department of Energy, Mines and Resources, Ottawa. The field data is now being processed at the Gravity Division, Ottawa, and four preliminary Bouguer anomaly maps will be published at a scale of 1 inch to 1 mile. An interpretation of the gravity features of the Red Lake area is under preparation.

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Barlow, R.B., Wadge, D.R. and Dusanowskyj, T.H.
1975: Bouguer Gravity Map of the Sturgeon Lake Area, District of Kenora and Thunder Bay; Ontario Div. Mines, Prelim. Map P.1050, Geophys. Ser., Scale 1 inch to 2 miles or 1:126,720. Survey and compilation 1974.

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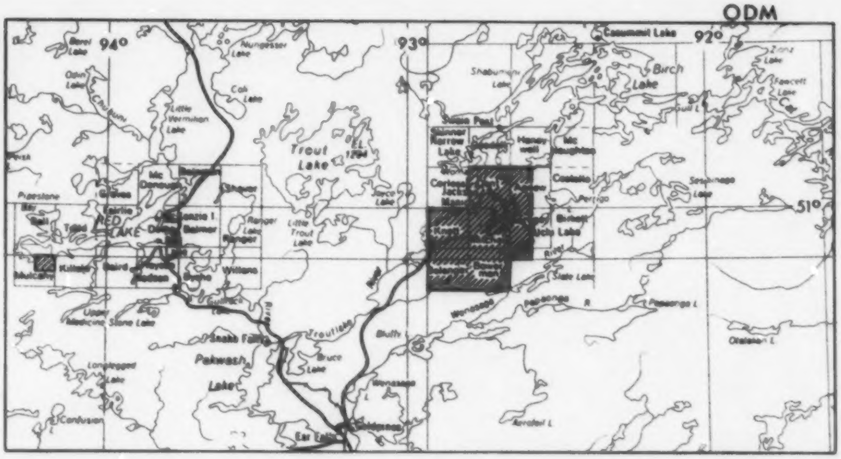
NO. 36 GEOLOGY AND GEOCHEMISTRY OF PYRITIC AND GRAPHITIC VOLCANOGENIC SEDIMENTS AND THEIR RELATIONSHIP TO MASSIVE SULPHIDE DEPOSITS

L.G. Closs[1] and A.C. Colvine[2]


ODM
94°
93°
92°
51°
Trout Lake
Birch Lake
RED LAKE
Pakwash Lake
Little Trout Lake
Upper Medicine Stone Lake
Snake Falls
Troutlake
Bruce Lake
Little Vermilion Lake
Nungesser Lake
Cat Lake
Casummit Lake
Shabumeni Lake
Seseganaga Lake
Uchi Lake
Slate Lake
Pakwash
Ear Falls
Perrigo
Mulcahy
Balmer
Ranger
Williams
Killala
Baird
Dent
Belanger
Mc Donough
Mc Naughton
Honeywell
Skinner
Narrow Lake
Graves
Costello
Confusion
Longlegged Lake
Pipestone Bay
Odin Lake
Joyce Lake
Bluffy
Pasco
Otatakan L

LOCATION MAP

Scale: 1:1,584,000 or 1 inch to 25 miles

INTRODUCTION

It has been shown in several mining camps that stratabound base-metal, massive sulphide deposits within Early Precambrian volcanic rocks may be located along a specific favourable horizon (Sangster 1972). A program was initiated in 1975 to investigate the geology and geochemistry of several of these favourable horizons and to attempt to define parameters which could be used to predict the existence and whereabouts of base metal concentrations. The interpretation of the environment of deposition and the genesis of these deposits is an integral part of the investigation.

The work carried out in 1975 was previously described by the authors (Closs and Colvine 1975). During the 1976 season, field work was continued in the Confederation Lake area, approximately 80 km (50 miles) east of Red Lake and was started in the Trout Bay area, Mulcahy Township, approximately 30 km (19 miles) WSW of the town of Red Lake.

CONFEDERATION LAKE AREA

The area covers a "zone" of sulphide mineralization believed to extend 22 km (14 miles) from the South Bay Mine in Dent Township to the Copper-Lode Mines Limited deposit in Belanger Township. The precise nature of the "zone" is not known, in fact the objective of the program is to define in geological, mineralogical and geochemical terms the nature of this zone along strike and to attempt to relate any variations to geological environment and genesis and also to proximity to concentrations of base metals. As a working definition, the zone consists of the lithostratigraphic units composed of or enclosing a number of sulphide mineral deposits which occur along strike between the South Bay and Copper-Lode deposits.

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The zone is situated within Cycle III (Thurston, *this volume*), formerly referred to as the Confederation Lake cycle, of the Birch-Uchi metavolcanic-metasedimentary belt. Cycle III is the uppermost of three volcanic cycles and the mineralized zone lies in the upper, intermediate to felsic portions of the cycle, close to the axis and on the west limb of the major syncline of the belt.

The sulphide mineral deposits are generally situated in felsic to intermediate pyroclastic rocks, close to their contact with underlying quartz-feldspar porphyry. The porphyry bodies do not form a continuous horizon, but appear to be at a similar stratigraphic level. The geological setting of the zone was described in more detail in last year's summary report (Closs and Colvine 1975).

Northeastern Area

The northeastern area covers the zone from the South Bay Mine to the northeastern corner of Horseshoe Lake. Within this area, no single continuous zone could be traced, although to the southwest of this area, the zone is continuous for several miles. Most of the upper, felsic and intermediate volcanic portion of the Cycle III was investigated up to 3000 m (10,000 feet) to the east and southeast of the regional synclinal fold axis. Individual rock units within the volcanic pile are not continuous enough along strike to allow a detailed stratigraphic interpretation of the sequence or relative location of the mineralized showings within it. The work did, however, confirm the overall southwest trend of the metavolcanic belt and its continuity to the southwest with the metavolcanics of the "Central Area" where the mineralized zone is more continuous. An additional 50 surface samples were collected completing coverage of the major units of the area.

In the immediate South Bay Mine area, Asbury (1975) demonstrated that foliation, lineation and minor fold axial trends diverge from the axial trend of the regional syncline immediately to the west of the mine. During 1976, the authors, with the assistance of Asbury, found that this pattern continues through the rocks to the south of the mine. Generally the structural trends are northeasterly, not parallel to the northerly strike of stratigraphic units. These structural trends are similar to those of the zone to the southwest which parallels the northeasterly trending fold axis in that area, but are different from the structural trends to the east and west which parallel the northerly trending fold axis in those areas. The cause of the structural divergence is not clear, but it may be related to the sharp bend of the regional fold axis about Triangle Lake. The change in direction of the fold axis from northeast to north would indicate that the area of structural divergence was affected by a northwest-southeast maximum compression.

Central Area

The central part of the zone extends from the northeast corner of Horseshoe Lake to a position 400 m (¼ mile) southwest of Arrow Lake. The greater part of the geochemical sampling was completed in 1975 (see Closs and Colvine 1975). One week was spent on field checking and fill-in sampling during the 1976 field season. An additional 215 drill-core samples were obtained.

Southwest Area

The southwest part of the zone extends southwest from Arrow Lake to a position approximately 1200 m (3,600 feet) southwest of Copper Lode Lake (local name). Field work in this area consisted of sampling of intermediate to felsic pyroclastic rocks and lesser quantities of felsic porphyry which form stratigraphic units along which a number of sulphide occurrences are located. In contrast to the central area, the porphyritic rocks in this area constitute a considerably smaller proportion of the intermediate to felsic volcanic sequence. The porphyritic unit is discontinuous, has a maximum apparent thickness of 30-50 m (100-150 feet), and is interlayered with intermediate to felsic tuffs and flows, thus suggesting, in part, an extrusive mode of formation. The porphyritic member is, however, spatially related to a majority of the sulphide showings in the field area and therefore may constitute a useful guide for prospecting. Sample sites were located relative to the Selco Mining Corporation Limited and Copper-Lode Mines Limited grids cut at 120 m (400 foot) intervals. Company geological maps at a scale of 1 inch to 400 feet (1:4800) provided the initial subdivision of rock types into sampling units. In total, 168 surface samples and 232 drill core samples were collected from this area.

The samples are being submitted to the Mineral Research Branch Laboratory of the Ontario Division of Mines, for sample preparation and chemical analysis. Major elements are being determined by standard X-ray fluorescence techniques and selected minor and trace elements (Cu, Pb, Zn, Co, Ag, As, Sb, Bi, Te, Se, Ba, Sn and B) are being determined by appropriate atomic absorption and emission spectrographic methods.

TROUT BAY AREA

Geological Setting

This project area is located in the northeast quarter of Mulcahy Township at the west end of the Red Lake "greenstone" belt. The area was mapped at reconnaissance scale by Horwood (1940), and at a scale of 1 inch to 800 feet (1:9600) by Riley (1969). The rocks within the area of interest consist of a northeast-facing monoclinal sequence of Early Precambrian metavolcanics and metasediments which are bordered on the east and southwest by granitic rocks. Mafic metavolcanics are exposed along the southwest margin of the belt. To the northeast, a metasedimentary sequence, consisting of argillite, greywacke, iron formation and intercalated course mafic to intermediate pyroclastic rocks, overlie the mafic metavolcanics. The metasediments are in turn overlain by a unit of predominantly intermediate pyroclastic rocks (tuff-breccia and breccia). Another sequence of metasediments overlies the pyroclastic rocks, and is exposed along the southwest shore of Trout Bay of Red Lake. The metavolcanic-metasedimentary pile has been intruded by mafic to ultramafic rocks (Kuryliw 1963).

This investigation is concerned with the bedrock geology and geochemistry of a base metal massive sulphide deposit which Riley (1969) described as follows:

> In part replacing greywacke, argillite, and metagabbro [the deposit] occurs in two west-plunging zones located about 800 feet apart on either side of the fault northeast of Fahlgren Lake. Drilling by Cochenour Willans Gold Mines Ltd. has indicated 13,766 tons grading 4.75% Zn, 0.68% Cu and 0.94 oz./ton Ag in the west zone, and 124,760 tons in the east zone grading 7.86% Zn, 1.50% Cu, 1.70 oz./ton Ag, 0.24% Pb and 0.007 oz./ton Au . . . .

Field Program

Time available and the presence of extensive areas of windfall restricted the sampling to an area extending from Johnson Lake in the southeast to a position approximately 300 m (1,000 feet) northwest of the north end of Fahlgren Lake. This area encompasses both mineralized zones described above. Gridlines of Cochenour Willans Gold Mines Limited, spaced at 30 m (100 foot) intervals, provided access and control for rock sampling. The surface sampling pattern was controlled by the location of known sulphide occurrences and outcrop distribution. Near the mineralized areas rock samples were collected on every line (100 feet) and this spacing was increased successively to 65 m (200 feet) and 120 m (400 feet) intervals, further away from the mineralized localities. Sampling was largely restricted to the metasediments which host the base metal mineralization, although the metavolcanics which underlie and overlie the metasediments, and mafic and ultramafic intrusive rocks were also sampled. In total, 397 surface samples were collected. In addition, 220 drill core samples were collected and will be used to provide data in areas of low outcrop density or difficulty of access.

Chemical Analysis

Initially 100 selected samples, representative of all major bedrock units, will be analysed for a full range of major, minor, and trace elements to assess which elements in what rock types are most diagnostic of the presence and proximity of mineralization.

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NO. 37 RECONNAISSANCE GEOCHEMISTRY OF PALEOZOIC ROCKS IN SOUTHERN ONTARIO

L.G. Closs[1]

The Geological Branch has initiated an investigation to establish the geochemical characteristics of the Paleozoic rock units exposed in southern Ontario. The basic data gained from this study will be of use in environmental geology and mineral exploration programs. Previous work by Vine and Tourtelot (1970) has indicated the wide range of elements associated with shales and argillites, many of which are significant in terms of environmental and prospecting projects. As the first phase of this investigation, four weeks were spent sampling the Upper Ordovician rocks, principally shales, (Queenston, Georgian Bay, and Whitby Formations, Hewitt 1972) exposed in south-central Ontario from the Niagara Escarpment east to Oshawa. These samples are being analyzed for both major (SiO_2, Al_2O_3, CaO, MgO, Na_2O, K_2O, Fe and Mn) and minor and trace constituents (Cu, Pb, Zn, Co, Ni, Mo, Cr, Ag, V, As, Hg, Cd, P, and B) by the Mineral Research Branch, Ontario Division of Mines, Toronto. Total carbon and carbon in the form of carbonate will also be determined. These data will assist in rock classification and establishment of the geochemical nature of the Upper Ordovician rocks of southern Ontario.

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[1] Geochemist, Geophysics/Geochemistry Section, Geological Branch, Ontario Division of Mines, Parliament Buildings, Toronto.

Mineral
Deposits
Section

SUMMARY OF ACTIVITIES
OF THE MINERAL DEPOSITS SECTION, 1976

J.A. Robertson[1]

The Mineral Deposits Section comprises the section chief and five mineral deposits geologists supplemented by temporary staff comprising geologists, geological assistants and back-up personnel as necessary. On April 1, 1976, D.G. Innes formerly Resident Geologist, Sudbury, joined the Mineral Deposits Section replacing M. Jost, who had resigned, as the nickel specialist.

Projects undertaken by the section cover: mineral deposit classification and distribution; mineral potential and reserve/resource analyses (either by commodity or by area); research on metallogenetic concepts and specialised studies on ore deposits. These studies emphasize geological environment, development of guidelines for exploration, and input to government planning in such sectors as land use planning, transportation corridors, and non-renewable resource management. The underlying principles and techniques have been described by Robertson (1975).

In late 1975 metal distribution maps for nickel have been published (Jost 1975b), the maps for gold are in press, and work is continuing on the corresponding maps for copper-lead-zinc, silver, and molybdenum. The final volume of Mineral Resources Circular "Gold Deposits in Ontario" (Gordon, Lovell and de Grijs 1975) has been placed on open file and staff of the section assisted in the completion of a report on the "Gold Deposits of the Kenora-Fort Frances Area" (Beard and Garratt 1976). The 1 inch to 16 mile mineral potential map of Ontario (Robertson, Vos and Springer 1976) prepared for the Ontario Strategic Land Use Plan has been published. Smaller scale versions are released in the appropriate O.S.L.U.P. reports. The initial series of 1 inch to 4 mile mineral potential maps covering the Grenville Province prepared by J.S. Springer are in press, and sheets covering the Southern and Superior Provinces are being prepared.

J. Robertson and J. Birch (Mineral Resources Branch) co-operated in the second annual study of uranium reserves of the Province in conjunction with the Uranium Resources Appraisal Program of the Canada Department of Energy, Mines and Resources (EMR 1976). This uranium program is being extended to cover undiscovered resources as well as reserves both in the economic and sub-economic categories. By year end most active deposits and areas in Ontario with exceptions of the alkalic complexes will have been visited by J.A. Robertson or B. Gordon; these include the following types and areas: Lower Huronian uraniferous pyritic quartz pebble conglomerates (Robertson 1976) and related deposits of the Southern Province; Lake Superior pitchblende occurrences at Theano Point and the Thunder Bay area including Greenwich Lake; simple or grey pegmatites of possible metamorphic origin at Sharbot Lake, MacTier, Greenwich Lake, Vermilion Bay and north of Kenora; red zoned complex, and unzoned pegmatites of possible igneous origin and skarn deposits of the Bancroft area. Only the conglomerates and the unzoned red pegmatites have supported production.

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Examination of the regional setting of the nickel deposits in the Abitibi area (Jost 1975a; Coad, *this volume*) and the iron deposits of the Wabigoon area (Meyn, *this volume*) have continued. Computer studies for resource studies are being developed. The evaluation of zinc-copper resources of the Province is being completed by Colvine and Birch and the base metal resource inventory programme is being expanded to cover nickel-copper resources (Innes, Colvine, and Birch).

Miscellaneous studies on silica, salt and asbestos deposits have been undertaken by M.A. Vos and programs to evaluate marble resources and the limestone industry have been initiated. A guidebook to Ontario's amethyst deposits has recently been released to the public. Examination of selected peat moss deposits adjacent to transportation corridors in northwest Ontario has been continued by B. Graham.

The distribution of carbonate rocks and their relationship to gold deposits in the Timmins area (Karvinen, *this volume*) is being studied by W.O. Karvinen, Regional Geologist, Ontario Ministry of Natural Resources, Timmins.

In addition, joint projects have been undertaken with other sections of the Geological Branch reflecting the need for multidisciplinary studies on mineral deposits. These include studies: on the pyritic-graphitic volcanogenic sedimentary rocks and the relationship to massive sulphide deposits as evidenced in northwest Ontario (Colvine and Closs, *this volume*); on the relationship of skarn type deposits to the Nipissing Diabase and Espanola Formation in the Southern Province (Card and Innes).

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NO. 38 NICKEL DEPOSITS ASSOCIATED WITH ULTRAMAFIC ROCKS WITHIN THE ABITIBI GREENSTONE BELT

Paul R. Coad[1]

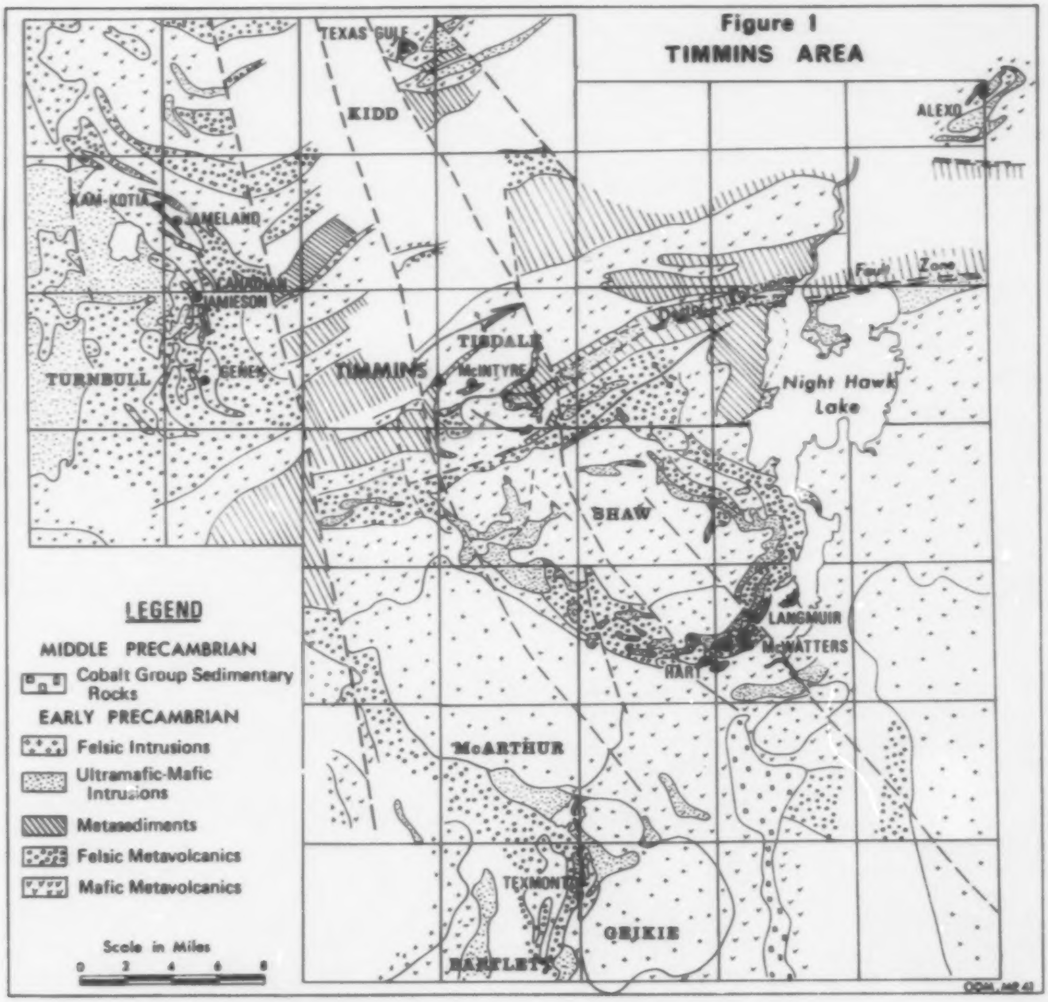

Figure 1
TIMMINS AREA

TEXAS GULF
KIDD
ALEXO
KAM-KOTIA
JAMELAND
CANADIAN
JAMIESON
TURNBULL
GENEX
TIMMINS
TISDALE
McINTYRE
DOME
Fault Zone
Night Hawk Lake
SHAW
LANGMUIR
McWATTERS
HART
McARTHUR
TEXMONT
GEIKIE
BARTLETT
LEGEND
MIDDLE PRECAMBRIAN
Cobalt Group Sedimentary Rocks
EARLY PRECAMBRIAN
Felsic Intrusions
Ultramafic-Mafic Intrusions
Metasediments
Felsic Metavolcanics
Mafic Metavolcanics
Scale in Miles
0 2 4 6 8

NOTE: The Sothman deposit is located 28 km (17.5 miles) south of Bartlett Tp., in Sothman Tp.

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INTRODUCTION

Jost (1975) initiated a study of the Nickel Deposits within the Abitibi and Wawa Subprovinces. Following the resignation of Dr. Jost, the writer, who had been Dr. Jost's assistant, was asked to complete that part of the project specifically concerned with the Abitibi Greenstone Belt (*sensu strictu*).

In 1976 the following deposits were examined and sampled: Alexo, McWatters, Langmuir, Texmont and Sothman (Figure 1). The majority of these deposits appear to occur in concordant extrusive ultramafic rocks at the base of the Tisdale Group which overlies intermediate to felsic metavolcanic, tuff, tuff-breccia and iron formation of the Deloro Group (Pyke 1975). The ultramafic flows are of variable thickness and in places exhibit spinifex textures. The Alexo deposit is located north of the Destor-Porcupine Fault (Figure 1) and precise stratigraphic correlation with the other deposits is not confirmed.

LANGMUIR DEPOSIT

At the Langmuir deposit (no. 2 zone) ultramafic flows average less than 30 m (100 feet) thick and are progressively thinner up sequence. Spinifex texture is best developed at higher stratigraphic levels in the ultramafic sequence. The underlying sequence consist of massive, intermediate to felsic metavolcanics, tuff and agglomerate. Massive nickel sulphide mineralization is concentrated at the footwall contact of the lowermost ultramafic flow unit. Disseminated or net-textured sulphide mineralization (Naldrett 1973) normally overlies the massive ore, but locally the massive ore is in sharp contact with barren peridotite, or disseminated sulphide mineralization alone forms the ore zone in places. A thin (10 cm) barren zone of peridotite locally separates the massive ore from overlying net-textured ore. Chromite occurs at the base of the massive ore and/or at the base of the net-textured sulphide mineralization adjacent to the massive ore. Nickel sulphide mineralization also occurs in spinifex-portions of the basal flow where the flow thins in one locality close to the footwall. Here sulphide mineralization occupies areas between blades of olivine usually marked by feathery pyroxene and devitrified glass (Pyke *et al.* 1973).

Zones of massive sulphide mineralization occur at higher stratigraphic levels in the ultramafic pile, and these occurrences may represent additional flows containing basal sulphide mineralization (Green, T., University of Toronto, 1976, personal communication). The proximity of these zones to the footwall and evidence of considerable faulting and shearing makes this interpretation questionable.

TEXMONT DEPOSIT

At the Texmont deposit the ultramafic sequence which hosts the sulphide mineralization is 300 m (430 feet) thick and individual flow units are only discernable by marked concentrations of spinifex texture. Spinifex textures, as at the Langmuir deposit, are best developed at higher stratigraphic levels in the ultramafic sequence, however discontinuous horizons of spinifex are located throughout the pile. The spinifex textures in the lower portions of the sequence are best described as porphyritic wherein coarse olivine crystals predominate (Nesbitt 1971). Footwall rocks to the ultramafic sequence consist of tuffaceous metasediments, iron formation, and local felsic agglomerate. Thin horizons of tuffaceous and locally graphitic metasediments occur throughout the ultramafic pile and have been locally intruded by concordant gabbro bodies.

Disseminated nickel sulphide mineralization is crudely localized about a gabbro dike in subparallel zones concordant to the ultramafic host rocks. The gabbro dike may have intruded the original feeder pipe to the system, very near to the occurrence of felsic agglomerate in the footwall. Disseminated sulphide mineralization is also associated with spinifex textures, where sulphide minerals occupy the spaces between elongate olivine grains. Faults have played a significant role in the concentration of sulphide mineralization.

McWATTERS DEPOSIT

A sill-like ultramafic body occurs within intermediate to felsic metavolcanics, tuff and agglomerate of the Deloro Group. Massive to disseminated sulphide mineralization occurs near the basal contact of the body against footwall metavolcanics.

SOTHMAN DEPOSIT

Here the ultramafic body consists of a dunitic core with pyroxene-rich peridotitic margins. The body measures 212 m (700 feet) thick and approximately 4 km (2.5 miles) long. No spinifex textures were observed in outcrop or drill core by the writer, nor have such textures been reported (Watkins 1972). Nickel sulphide mineralization occurs as net-textured ore along embayments in the footwall which consists of amygdaloidal basalt, felsic metavolcanics and agglomerate. Neither contact metamorphism of the volcanic rocks nor chilling of the ultramafic body have been observed.

ALEXO DEPOSIT

The Alexo deposit, like the Sothman, has a dunitic core with pyroxene-rich margins. One small patch of spinifex occurs within the body which measures 70 m (230 feet) thick and approximately 500 m (1,600 feet) long. Massive nickel sulphide mineralization is concentrated in embayments at the base of the body, atop the pyroxene-rich margin or against the footwall which consists of Mg-rich basalts. Massive ore is in sharp contact with overlying net-textured ore. Portions of the basal peridotite interfinger with hyaloclastite.

DISCUSSION

The occurrence of felsic agglomerate in the footwall at the Texmont and Langmuir deposits might suggest proximity to a feeder-pipe. Ultramafic rocks in the Shangani Nickel Deposit of Rhodesia, were extruded through a felsic vent, now marked by felsic agglomerate according to Viljoen *et al.* (1976).

The Sothman and Alexo deposits may represent a proximal type of ultramafic flow unit. The insignificant development of spinifex might have been an effect of the extrusion of a large pulse of phenocryst-enriched liquid close to a volcanic conduit. Spinifex is not well developed in flows near the footwall at the Langmuir and Texmont deposits. The local but intimate development of hyaloclastite within the Alexo body would support an extrusive origin.

The irregular distribution of massive and disseminated sulphide mineralization at the Langmuir and Alexo deposits, the occurrence of sulphide-bearing spinifex and the zonation of sulphide mineralization at the Texmont deposit indicate that the separation of an immiscible sulphide liquid from an ultramafic liquid (Naldrett 1973) is complex.

A more complete description of the above deposits with chemical analyses and petrographic work will be published in a final report for this project.

RECOMMENDATIONS FOR EXPLORATION

The following points might be useful in the practical exploration for nickel sulphide deposits associated with ultramafic volcanics.

1. *The significance of stratigraphic control, particularly in the Timmins camp.* Efforts might best be directed toward ultramafic units located at the base of the Tisdale Group (Pyke 1975). Similar stratigraphic settings in other belts should be regarded as favourable target areas (cf. Western Australia, Gemuts and Theron 1975).
2. *The presence of felsic agglomerate or breccia in the footwall of ultramafic bodies.* These rocks may delineate centres through which the ultramafic liquid was extruded. Sulphide mineralization may be localized in the ultramafic body above such centres.
3. *Well developed spinifex bearing flow units*, particularly thin units, could indicate a high stratigraphic position in an ultramafic pile, and/or a position laterally removed from the area of a probable volcanic conduit, in areas of incomplete outcrop exposure. These distal flows are less likely to host significant sulphide mineralization, as they are less magnesium-rich.
4. *The recognition of penecontemporaneous faults* in a favourable environment might indicate areas favourable for significant sulphide concentration.

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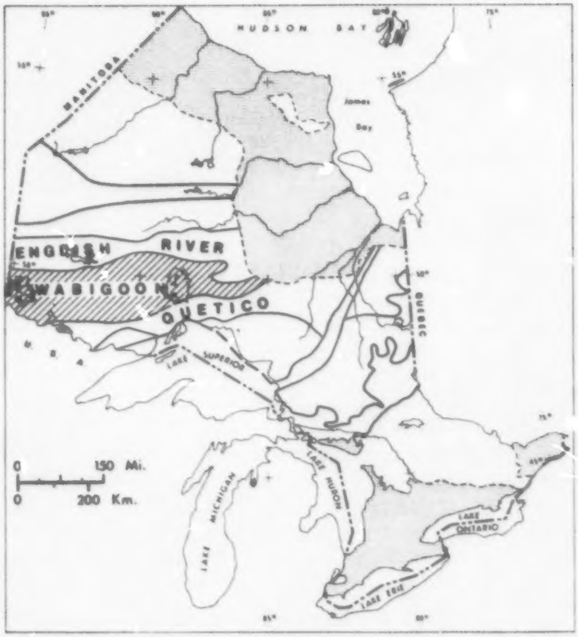
NO. 39 IRON DEPOSITS OF THE WABIGOON BELT

H.D. Meyn[1]



LOCATION MAP (*after* Mackasey *et al.* 1974)

The author is engaged in a study of the iron deposits of Ontario. The aim of this study is a) to provide the Ontario Government with an assessment of iron resources, and b) to gain some understanding of the genesis of the iron deposits of the province and their role in the evolution of the geology of Ontario.

The geological Belts (subprovinces) were selected as suitable work units.

The study of the initial segment covers the Wabigoon Belt of the Superior Province. The Wabigoon Belt is a recognized but not completely defined or delineated subdivision of the Superior Province. A broad outline of the Belt is shown in Diagram A on Map 2196 by Ayres *et al.* (1971a). A similarly broad outline is shown in Figures V-2,3,4 by A.M. Goodwin (1968). Mackasey *et al.* (1974) discussed the mineral potential of the Wabigoon-Quetico Belts. They stated:

> The Quetico, Wabigoon, and English River Belts are primarily unique lithostratigraphic entities, which have been subjected to crustal and subcrustal modifications that are reflected geologically in their contrasting structural styles and metamorphic regimes, and geophysically in their contrasting aeromagnetic and gravimetric responses....
>
> The Quetico and English River Belts are an assemblage of metasediments and metasedimentary gneisses, migmatites, and granitic rocks of magmatic and anatectic origin. In contrast, the Wabigoon Belt is an assemblage of metavolcanic, volcaniclastic, and minor metasedimentary rocks that have been intruded by granitic rocks. The initial boundaries between these belts are thought to have been stratigraphic in nature and represented by a facies change from a predominantly volcanogenic to a predominantly epiclastic environment. Although these boundaries, or interfaces, are now locally marked by zones of structural weakness, e.g. the Quetico Fault... it is suggested that such structures are primarily the result of tectonic overprinting with major dislocation occurring along areas of lithologic discontinuity.

The location map above reproduces the boundaries of the Belts as shown in Figure 1 of Mackasey *et al.* (1974). With regard to the northern boundary of the Wabigoon Belt they state (Mackasey *et al.* 1974, p.4):

"The boundary between the English River and the Wabigoon Belts is not discussed as it is at present only tenuously defined due to lack of critical information." However, the subdivisions of the Superior Province into Belts seems to reflect real geological difference and hence is a useful tool.

The regional geology of the belt is best seen on the 1:1,013,760 (1 inch to 16 miles) scale geological map of Ontario, Map 2199, West Central Sheet (Ayres *et al.* 1971b).

In the Wabigoon Belt over 100 iron deposits are known and catalogued (Shklanka 1968) and shown on the West Central Sheet of the Iron Deposits Map of Ontario (Meyn and Robertson 1975). Several major iron deposits have been known for many decades and with improved access and aeromagnetic maps the large ones have been examined for their commercial potential. The author visited 37 already known iron deposits. Of the deposits visited the great majority are Algoma-type, oxide-facies iron formation (Gross 1965, p.90, fig.3).

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In most deposits iron-rich laminae (magnetite or hematite) are interlayered with clastic sedimentary rock. The most common sedimentary rock is greywacke but siltstone and mudstone (argillite) occur as well as volcanoclastic sedimentary rocks. This association commonly occurs in thicker (several hundred to several thousand metres) sequences of Archean metasediments such as those at Savant-Kashaweogama Lakes, the Sioux Lookout, Dryden, and Beardmore-Geraldton areas.

In a few deposits iron-rich laminae are interlayered with chert or recrystallized chert. Such iron formation is commonly associated with very thin sedimentary sequences, or in other occurrences, sedimentary rocks are completely absent and the iron formation is interbedded with volcanic rocks. The best known examples of such deposits are the Sherman and Moose Mountain Mines. Examples in the Wabigoon Belt are found on Eagle Lake, southwest of Dryden, and at Armit Lake, northwesterly from Savant Lake station.

Possibly a gradation exists between iron formation of these two associations, however, one can generally assign a deposit to one or the other. As the associated rock types are indicators of different depositional environments, these two associations which have genetic implications should be further studied.

In addition to Algoma-facies iron formation, several other types of iron deposits are present in the Wabigoon Belt. Magnetite is associated with a mafic igneous intrusion along the northwestern shore of Rainy Lake (Harris 1974). Pyrite-pyrrhotite bodies on Eagle Lake are described by Moorhouse (1939) as replacement types, and on Finlayson Lake are described by Fenwick (1976) as exhalite.

The iron deposits examined were sampled to identify their mineralogical and chemical composition. Selected samples will have polished thin sections, thin sections, or polished sections cut from them so that their texture, mineralogy and grain size can be studied. Some mineral identifications will be checked by the X-ray diffraction method. A smaller number of samples will be analysed for major, minor, and trace elements to determine what, if any, the differences are between different iron deposits.

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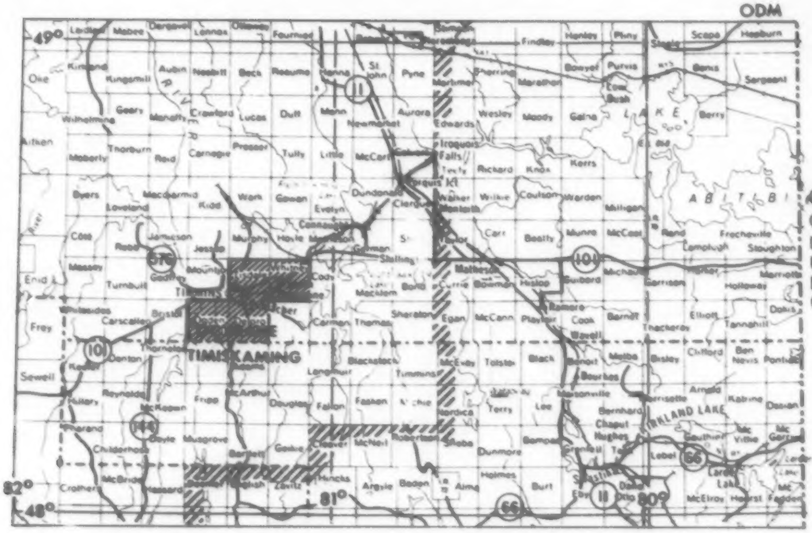
NO.40 DISTRIBUTION OF CARBONATE-RICH ROCKS, PORPHYRIES AND GOLD DEPOSITS, TIMMINS AREA

W.O. Karvinen[1]


ODM
QUEBEC
LAKE ABITIBI
TIMISKAMING
KIRKLAND LAKE
49°
48°
82°
81°
80°
11
101
144
576
66
Iroquois Falls
Timmins
Matheson
Larder Lake
Tisdale
Whitney
Deloro
Ogden
Mountjoy
Hoyle
Murphy
Jessop
Godfrey
Bristol
Carscallen
Thorneloe
Denton
Kidd
Wark
Gowan
Evelyn
Dundonald
Clergue
Walker
Beatty
Carr
Munro
McCool
Stock
Cody
German
Fournier
Findlay
Hanna
Pyne
Aurora
Newmarket
Mann
Kingsmill
Aubin
Nesbitt
Beck
Geary
Lucas
Duff
Carnegie
Prosser
Tully
Thorburn
Reid
Moberly
Byers
Loveland
Macdiarmid
Turnbull
Massey
Enid
Frey
Sewell
Keefer
Reynolds
McKeown
Fripp
McArthur
Douglas
Fallon
Bartlett
Eldorado
Egan
McCann
Playfair
Teck
Lebel
Gauthier
Hincks
Argyle
Bowman
Currie
Hislop
Guibord
Michaud
Garrison
Holloway
Marriott
Elliott
Tannahill
Ben Nevis
Pontiac
Clifford
Bisley
Catharine
Gross
McElroy
Burt
Holmes
Dunmore
Boston
Benoit
Larder
Fecteau
Bernhardt
Chaput Hughes

LOCATION MAP Scale: 1:1,584,000 or 1 inch to 25 miles

A field investigation to determine the distribution and geometry of carbonate-rich rocks and their spatial and genetic relationship to gold deposits was conducted in the Timmins area during the summer of 1976. The area covered includes the Townships of Tisdale, Whitney, Deloro and Ogden.

The main objectives of the study were: 1) to delineate geological exploration parameters which could be used to locate gold mineralization in overburden areas; and 2) to determine the potential of the area for low-grade, high-tonnage type deposits, amenable to open-pit mining.

Results of the investigation are listed below:

1. Two major carbonate-rich units, varying in thickness from 20 m (60 feet) to over 200 m (600 feet) are present in the Timmins area.
2. Both units form distinct stratabound horizons which can be followed for over 16 km (10 miles).
3. All major gold deposits in the area as well as all quartz-feldspar porphyries occur on these two carbonate-rich horizons.
4. The carbonate-rich rocks consist predominantly of ankerite and/or magnesite and represent carbonatized ultramafic flows, basalts and tuffs. Only a small proportion of carbonate rock of probable sedimentary origin occurs in thin lenses within the two units.

The field evidence suggests that gold was concentrated during two distinct geological events: 1. volcanism and 2. regional metamorphism and deformation.

The initial enrichment of gold occurred during felsic volcanism (formation of porphyries) and associated exhalative activity which resulted in the carbonatization of a variety of volcanic rocks on the ocean floor. It was at this time that gold, along with a host of other elements, was concentrated in the carbonatized rocks.

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Subsequent metamorphism and deformation remobilized the gold from the carbonate-rich rocks and further concentrated it into a network of quartz-carbonate veins.

The study illustrates the stratabound nature of gold mineralization in the Timmins area and suggests that gold was first enriched in the rocks during volcanism and related processes similar to those associated with the formation of volcanogenic, massive, base metal deposits.

GUIDELINES FOR EXPLORATION

1. Best potential for gold exists within or near carbonate-rich rocks and associated porphyries. Carbonatized rock in fresh drill core is easily missed and is often logged as dacite, bleached andesite, etc. Any "bleached" volcanic rock should be stained to determine its carbonate content.

2. Best concentrations of gold along carbonate-rich horizons occur:

i. Near large porphyries associated with carbonate-rich rocks in well-deformed rocks (e.g. Hollinger; McIntyre; Dome).

ii. At fold noses or flexures in carbonate-rich units associated with thin lenses of porphyry (e.g. Aunor; Buffalo Ankerite; Naybob; DeSantis; Delnite).

iii. In areas where carbonate-rich units intersect an unconformity (e.g. Pamour; Hoyle; Hallnor; Broulan Reef; Dome), at these localities Temiskaming metasediments overlie carbonate-rich rocks at a local angular unconformity.

3. Not all parts of carbonate-rich rocks contain economic concentrations of gold in veins. Those parts containing none or very few veins may have significant potential for low-grade, high-tonnage type deposits. At present some of these rocks are being analyzed by the Mineral Research Branch to learn more about their chemistry.